International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST2310133

Basic School Integrated Science Teachers' Pedagogical Content Knowledge and Its Usefulness in Their Lessons Delivery

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Article Info

Publication Issue
Volume 10, Issue 1
January-February-2023

Page Number
423-433

Article History
Accepted: 01 Feb 2023
Published: 15 Feb 2023

ABSTRACT

The study investigated basic school integrated science teachers' pedagogical content knowledge and its usefulness in their lesson's delivery. The study was carried out within basic schools in the Kassena Nankana Municipality. Two research questions were formulated for the study. Purposive sampling technique was adopted for the study. 100 integrated science teachers were sampled for the study. Self-developed questionnaire was formulated and used for collecting data from the participants. The reliability of the items was determined using Cronbach alpha coefficient of reliability. The data collected were analysed using descriptive (mean, percentage and standard deviation) and inferential statistics (ANOVA). The results of the study proved that integrated science teachers PCK play a very significant role in their lessons delivery. The results of the study also indicated that peer observation and mentoring, professional upgrading, observation visits to other schools, individual and collaborative research and workshops are the major key policies capable of improving integrated science teachers PCK. Based on the findings, it was therefore recommended that in-service training should be organised frequently for teachers at the basic level, Ghana Education Service and Ministry of Education should increase the quota for study leave with pay for integrated science teachers at the basic level and newly trained teachers should be given mentorship by experienced teachers.

Keywords: Pedagogical Knowledge, Content Knowledge and Lesson Delivery

I. INTRODUCTION

In recent years, many questions have been raised by individuals most especially parents on teachers pedagogical and content knowledge due to the declining academic performance of students. It is an established fact that any country that aim to progress significantly must invest in its educational system and

also provide its students with professional teachers who possesses high level of pedagogical content knowledge (PCK). Pedagogical content knowledge combines pedagogy and content (subject matter) knowledge. Pedagogy deals with the instructional or teaching methodologies while the content knowledge also deals with the understanding of the subject matter (Kultsum, 2017). Pedagogical content knowledge concerned with teachers' understanding of subject matter as well as the strategies adopted by the teacher in presenting the subject matter to students. Mapulanga, Nshoyoza and Ameyaw (2022) asserted that PCK constitutes the knowledge used by teachers to transfer knowledge in their subject areas like integrated science, Biology, Chemistry and physics into a form that students can understand regardless of their background.

Shulman (1987) opined that a facilitator requires seven knowledge bases in order to teach effectively. These include; pedagogical content knowledge; content knowledge; general pedagogical knowledge; knowledge of students and their characteristics; curriculum knowledge; knowledge of educational context; and knowledge of educational ends, purposes and values. On the other hand, Smith and Neale (1989) argued that teachers needed to know subject matter, content instructional methods and learners' traits in order to teach. Sneider and Plasma (2011) also identified five broad areas of PCK. These are; orientation to teach science; thinking about science; instructional methods in science teaching; the science curriculum; and assessment of students' science learning.

Teachers pedagogical content knowledge significantly affect students' academic success. Available evidence from researchers proved that teachers' intellectual resources positively affect learning experiences (Odumosu, Olusesan, & Abel, 2016). This triggered most educational institution mandated to train teachers for the country to place more emphasizes on pedagogy knowledge and content knowledge. This will help them to function effectively in the teaching field. The importance of a teacher in teaching and learning process proved that pedagogical content knowledge of the teacher is paramount. The teacher should master the subject matter to be taught and present it to students using an instructional approach that will enable them to understand the concept better.

Techer need to understand the concept very well and also know how to convey it to students so that they can map it with their ideas, relate it to another and redirect their thinking to create deep learning (Kandasamy, Yunus, & Embi, 2018). Students who are taught by teachers with high pedagogical content knowledge performed better than those taught by teachers with low pedagogical knowledge (Odumosu, Olisama, & Fisayo, 2018). This implies that teachers with high PCK are able to create a learning environment that is challenging and supports students with different learning styles and at the same time overcome learners' misconceptions and challenges (Keller, Neumann, & Fischer, 2017). Teachers with high PCK helps their students to have deeper understanding of concept or subject matter (Puspitaningtyas & Endang, 2021). Such teachers always present concepts and issues logically and clearly. Teacher with high PCK also vary their instructional strategies which helps to cater for all students in the class.

1.1 Statement of the Problem

The study examined pedagogical content knowledge of basic schools integrated science teachers and its usefulness in their lesson's delivery. There have been a lot of training for teachers in Ghana on instructional approaches that have the tendency of improving the academic achievement of students. In Ghana, 46 colleges of education and few universities are mandated to provide teacher trainees with the necessary skills to enable them fit properly in the teaching field. These colleges and universities offer programmes with educational courses such as

educational technology, principles and practice of teacher education, curriculum development, method of teaching, psychology of human growth and development, research methods, and communication skills. All these courses are tilted towards making the individual a professional teacher. These courses help teachers to delivery their lesson effectively and efficiently. Teachers from the colleges are posted to basic schools within the country where their services are needed to teach based on their area of specialization. Trained teachers who specialized in mathematics and science are posted to the basic level to teach mathematics and science. Such teachers are normally equipped with the competence to handle such subjects, yet the academic performance students in science and mathematics continue to decline in the Basic Education Certificate Examination (BECE). Many students could not proceed to the senior high school due to their poor performance in mathematics and science. It is against this background that the researchers deemed it important to investigate the effect of pedagogical content knowledge (PCK) on integrated science teachers lesson delivery and policies that can be implemented to help improve their PCK in order to enable them improve on their lesson delivery.

1.2 Purpose of the Study

The main purpose of the study was to explore basic schools integrated science teachers pedagogical content knowledge and its usefulness in their lesson delivery within kassena Nankana Municipality in the Upper East Region of Ghana. Another rationale for carrying out this study was to determine measures or policies that can be implemented by educational bodies such as Ghana Education Service (GES), Ministry of Education (MoE) and other Non-Governmental Organizations (NGOs) interested in education to help improve the pedagogical content knowledge of integrated science teachers at the basic level.

1.3 Specific objectives of the Study

The specific objectives of the study were to examine the:

I. Effects of pedagogical content knowledge on basic schools integrated science teachers' lesson delivery.
II. Measures that can be implemented to improve basic school integrated science teachers' pedagogical content knowledge.

1.4 Research Questions

The following research questions were formulated to address the study:

I. What are the effects of pedagogical content knowledge on basic school integrated science teachers lesson delivery?
II. What measures can be implemented to improve basic school integrated science teachers pedagogical content knowledge?

1.5 Research Hypothesis

The null hypothesis was tested at 0.5 significant level.

Basic school integrated science teachers pedagogical content knowledge has no effect on their lesson delivery.

II. LITERATURE REVIEW

2.1 Subject Matter Knowledge (SMK) /Content Knowledge (CK)

Content knowledge (CK) is knowledge about the subject matter that the teacher presents to students. Content knowledge is the teacher's conceptions of theories, laws and principles as well as understanding of the structures of the subject matter (Wilson, Shulman, & Richert, 1987). Shulman (1987) posited that "content knowledge is the amount and organization of knowledge per se in the mind of the teacher". Subject matter knowledge is the knowledge that teachers acquired during their study at colleges of educations and universities that covers all curriculum courses related to their areas of specialization (Al-Jaro, Asmawi , & Hasim, 2017). Content knowledge

goes beyond knowing theories, rules, principle and facts to include a comprehension of how the principles, concepts and theories of a subject and the rules of evidence and proof that are used to justify claims in a particular subject (Lange, Kleickmann, & Möller, 2011). Students should have deeper and wider understanding of the subject matter since the content is the aspect presented to learners (Alimuddi et al; 2021). Integrated science has both theory and practical component and hence teachers need to acquire knowledge in both areas in order to effectively teach the subject. Integrated science teachers' study both practical and theory part and are also provided with training by science educational experts that enable them to handle both aspects.

2.2 Pedagogical Knowledge (PK)

Pedagogical knowledge (PK) is an important element of PCK that teachers should obtain during training at the colleges of education and universities. Pedagogical knowledge is knowledge of instructional strategies that helps the facilitator to effectively carryout the teaching activity. Shulman (1987) defined PK as "broad principles and strategies of classroom management and organization that appears to transcend subject matter" Faisal (2016) also asserted that pedagogical knowledge is "the knowledge on teaching strategies and ways that a teacher requires to deliver and more importantly to transform subject matter to learners, consistently with their interest and potential". PK is knowledge of teaching methodologies that teachers applied in the classroom during teaching process to enhance learners understanding of the subject matter. PK plays a very crucial role in making the instructional practice more comprehensible to learners (Al-jaro et al,). Tertiary institutions with accreditation to train teachers should equip teachers with the necessary teaching skills such as content knowledge and pedagogical knowledge in order to enable them deliver their lessons and manage classrooms very well. This can be done by placing more emphasizes on courses with aspects such as teaching methodologies, classroom management, improvisation and teaching and learning of science. Teachers with high PK are able to deliver the subject matter perfectly to students using appropriate teaching strategy. Pedagogical knowledge is also acquired through several years of teaching experiences. Hence teachers with long service teaching experiences should guide newly trained teachers in the teaching field in order to improve their PK.

III.METHODOLOGY

3.1 Research Design

A cross-sectional design was adopted for the study. A cross-sectional design is a form of research design that enables the researcher to collect data from many different participants at a single point in time (Thomas, 2022). This type of research design was adopted for the study because it is relatively cheap and consume little time. It also allows the researcher to collect large pool of data from subjects and compare differences between groups.

3.2 Study Area

This study was conducted in basic schools within Kassena Nankana Municipality in the Upper East Region. Kassena Nankana Municipality is one of the largest Municipalities in the Region. The municipality has 1 University, 1 Teacher Training College, 1 Community Nursing Training College, 6 Senior High Schools and many primary and Junior High Schools, both public and private.

3.3 Population

The population of the study included all teachers at the basic level within Kassena Nankana Municipality.

3.4 Sampling Technique and Sample Size

Purposive sampling technique was adopted for selecting integrated science teachers at the basic level for the study. Integrated science teachers with two or more years teaching experience were sampled for the

study. A total of 100 integrated science teachers were sampled for the study.

Table 1 indicates the demographic profile of respondents. 78% of the participants were males and 22% of them were also females. In terms of academic qualification, 72% had diploma in basic education and 28% had degree. None of the participants had master degree. Also, 49% of the total population had 2-5 years of teaching experience, 37% had 6-10 years of teaching experience and 14% of the participants had 11-15years of teaching experience.

Table 1. Demographic Profiles of Subjects/Respondents

Variables and Categories		
Gender	**Academic qualification**	**Years of teaching experiences**
Male (78)	Diploma (72)	2-5 (49)
Female (22)	Degree (28)	6-10 (37)
	Master (0)	11-15 (14)
		16-20 (0)

Note: figures are in Percentages (%), N=100

3.5 Research Instruments

A structured closed-ended questionnaire was used to elicit information from integrated science teachers on effect of pedagogical content knowledge in their lesson delivery. The questionnaire was a 4-point Likert scale type with the following anchors: strongly agree (SA) =4, agree (A) =3, disagree (DA) =2 and strongly disagree (SD) =1. Interview was also conducted to determine policies or measures that can be implemented to help integrated science teachers improve their pedagogical content knowledge.

3.6 Data Analysis

The data collected from the teachers were analysed using inferential statistics (ANOVA) and descriptive statistics (mean, standard deviation and percentages) using Statistical Package of Social Sciences (SPSS).

IV. FINDINGS AND DISCUSSION

This study investigated basic school integrated science teachers' pedagogical content knowledge and its usefulness in their lesson delivery. The study use questionnaire and interview to obtain data from the participants.

Table 2 : Integrated Science Teachers Responses on Effect of Teachers' Pedagogical Content Knowledge (PCK) on Integrated Science Lesson Delivery

S/N	Statement	SA n (%)	A n (%)	DA n (%)	SD n (%)	Mean	SD	Rank
1	PCK aids teachers to have full command of the subject matter	24(24)	69(69)	6(6)	1(15)	3.16	0.56	2
2	PCK helps facilitators to give good introduction of lesson	16(16)	77(77)	7(7)	0(0)	3.09	0.47	3
3	PCK helps facilitators to monitor students' progress and provide feedback that aids progress	17(17)	68(68)	14(14)	1(1)	3.01	0.59	4
4	PCK does not enable teachers to assess students very well	1(1)	2(2)	4(4)	93(93)	1.11	0.45	11
5	PCK of teachers does not ensure sequential and logical presentation of integrated science lesson	0(0)	1(1)	3(3)	96(96)	1.05	0.26	12

6	PCK enables teachers to control students during instructional process	3(3)	89(89)	2(2)	6(6)	2.89	0.53	6
7	PCK does not help teachers to motivate students during lesson delivery	1(1)	4(4)	46(46)	49(49)	1.57	0.62	9
8	PCK enables teachers to vary their instructional strategies to cater for diverse learning needs of learners in the class	3(3)	87(87)	2(2)	8(8)	2.85	0.59	7
9	PCK does not guide teachers on how to support weaker learners in the class	3(3)	2(2)	14(14)	81(81)	1.27	0.65	10
10	PCK helps teachers to present lesson in a systematic manner	19(19)	79(79)	2(2)	0(0)	3.17	0.43	1
11	PCK supports teachers to make effective use of TLMs during lesson delivery	13(13)	74(74)	4(4)	9(9)	2.91	0.43	5
12	PCK enables teachers to provide good closure of lesson	24(24)	4(4)	69(69)	3(3)	2.49	0.89	8
	Grand mean					2.40	0.60	

Source: Field data (2023)

Key: *4=Strongly Agree (SA), 3=Agree (A), 2=Disagree (DA), 1=Strongly Disagree (SD), Mean (M) and Standard Deviation (SD).*

Table two (2) contains responses of integrated science teachers on effect of pedagogical content knowledge (PCK) in their lesson delivery. The teachers indicated their level of agreement to each of the twelve items on a scale that ranged from 4= strongly agree (SA), 3=agree (A), 2= disagree (DA) and 1=strongly disagree (SD). The items were further ranked on the base of the one with the highest mean to the one with the least mean (Ayimbila et al; 2022).

Majority of the integrated science teachers participated in the study were of the view that pedagogical content knowledge helps them to deliver their lessons effectively. The mean value for most of the item were above 2.50. this proved that PCK play a significant role in their lesson's delivery. Among the twelve items, PCK helps teachers to present lessons in a systematic manner was ranked 1st (M=3.17, SD=0.43). 19% of the participants responded strongly agree, 79% responded agree, and 2% also responded disagree. None responded strongly disagree. PCK aids teachers to have full command of the subject matter ranked 2nd (M=3.16, M=0.56). 24% of the integrated science teachers responded strongly agree, 69% responded agree, 6% responded disagree and 1% responded strongly disagree. PCK helps facilitators to give good introduction of lesson was ranked 3rd (M=3.09, SD=0.47). 16% of the teachers responded strongly agree, 77% responded agree, 7% responded disagree. PCK helps facilitators to monitor students' progress and provide feedback that aids progress ranked 4th (M=3.01, SD=0.59). 17% of the respondents responded strongly agree, 68% responded, 14% responded disagree and 1% responded strongly disagree.

PCK does not help teachers to motivate students during lesson delivery was ranked 9th (M=1.59, SD= 0.62). 1%

of the participants responded strongly agree, 4% responded agree, 46% responded disagree and 49% responded strongly disagree. PCK does not guide teachers on how to support weaker students in the class ranked 10th (M=1.27, SD= 0.65). 3% of the respondents responded strongly agree, 2% responded agree, 14% responded disagree and 81% responded strongly disagree. PCK does not help teachers to assess students very well was ranked 11th (M=1.11, SD=0.45). 1% of the integrated science teachers responded strongly agree, 2% responded agree, 4% responded disagree and 93% responded strongly disagree. Finally, PCK of teachers does not help to ensure sequential and logical presentation of lesson was ranked least (M=1.05, SD=0.26). 1% of the participants responded agree, 3% responded disagree and 96% responded strongly disagree.

Table 3. ANOVA Results on Effect of Integrated Science Teachers' Pedagogical Content Knowledge on their Lesson Delivery

ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	817.749	11	74.34	216.883	0.000	1.797
Within Groups	407.21	1188	0.34			
Total	1224.96	1199				

Level of significant =0.05; p<0.05; Highly significant

From table 3, (F (11,1188) =216.88, p = 0.00< 0.05) showed that there was statistically significant difference between integrated science teachers pedagogical content knowledge (PCK) and their lesson delivery. Since the p-value is less than 0.05, the null hypothesis which stated that integrated science teachers pedagogical content knowledge has no effect on their lesson delivery was rejected. This is an indication that PCK of integrated science teachers at the basic level helps them to deliver their lessons effectively and efficiently.

Research question 2 was also formulated to examine measures that can be implemented to help basic school integrated science teachers improve their PCK. The study established five measures or policies based on the responses of the participants. These include;

Workshops and courses: Majority of the respondents mention workshops. They were of the view that workshop is one of the major policies that can be put in place to help them improve the PCK. It is therefore, important that Ghana Education Service (GES) and Ministry of Education (MoE) organize workshops frequently for teachers on current instructional approaches that are capable of helping integrated science teachers to deliver their lessons properly. The District, Municipal and Regional directors of education can also organize workshops at the district and regional level for teachers in order to help them grow professionally. Participants also opined that short term courses should be organized for teachers at the basic level and this will improve their PCK.

Observation visits to other schools: The participants also opined that regular visit to other schools more especially schools with adequate teaching and learning materials will help them improve their PCK. The participants also argued that teachers at the well-resourced school should be send frequently to schools in remote areas to support teachers especially newly trained teachers.

Individual and collaborative research: Integrated science teachers sampled for the study also stated that basic school teachers should be given adequate

training on how to carryout research so that individual teachers or teachers can come together and carryout studies on teaching and learning which has the tendency of helping them to improve their pedagogical content knowledge.

Professional upgrading: upgrading is one of the ways through which teachers pedagogical content knowledge can be improved. 75% of the participants were of the view that teachers at the basic level should be given the opportunity to upgrade themselves academically and professionally. More doors need to be open to integrated science teachers at the basic level to help them further their education in order to enable them acquire more knowledge in their area of specialization and improve their teaching styles. This can be done by providing scholarship for teachers at the basic level and more emphasizes should be place on the sciences. 20% of the teachers said the quota system for upgrading is highly affecting some of them negatively and hence the government through GES and MoE should increase the number of teachers for study leave with pay and also place more emphases on integrated science teachers.

Peer observation and mentoring: 73% of the participants sampled for the study stated that peer observation and mentoring will help integrated science teachers improve their PCK. They were of the view that teachers with many years teaching experience should mentor those with less experience more especially the newly posted teachers. 15% of the teachers sampled for the study stated that experience is the best teacher and hence those who taught integrated science for many years will be in the best position to mentor the less experience teachers on classroom management, lesson preparation, lesson introduction, statement of lesson objectives, systematic presentation of lesson, evaluation of students learning.

V. DISCUSSION

The purpose of this study was to explore integrated science teachers' pedagogical content knowledge and its effect on their lessons delivery and to also determine policies that can be put in place to help the facilitators improve their pedagogical content knowledge. The results of the study proved that pedagogical content knowledge of integrated science teachers play a tremendous role in their lessons delivery.

The finding of the study revealed that there was statistically significant difference between integrated teachers pedagogical content knowledge and their lessons delivery. This proved that integrated science teachers PCK helps them to deliver their lesson properly. This finding collaborates the finding of Odumosu et al.; (2018) who conducted a study on teachers' pedagogical content knowledge on students' academic achievement in algebra and confirmed students who were taught by teachers with high pedagogical performed significantly better their cohorts who were also taught by teachers with low pedagogical content knowledge. This is a clear indication that pedagogical content knowledge of a teacher is very paramount in his/her lesson delivery. The finding is also consistent with Kultsum (2017) who explored the concept of pedagogical content knowledge: recognizing in English teachers' competencies in Indonesia and concluded that PCK helps teachers to understand how to explore their content knowledge and how to deliver it properly to students. This shows that PCK aids instructors to deliver the subject matter effectively to students. The finding further confirmed the finding of Kola and Sunday (2015) who examined teacher self-efficacy and out-of-field teaching and concluded that teachers with very sound in subject matter impart well to students using proper instructional strategy.

The findings also revealed that peer observation and mentoring, individual and collaborative research, professional upgrading, observation visits to other schools and workshops are the means through integrated science teachers pedagogical content

knowledge can be improved. This finding is in line with Kadasamy et al., (2018) that novice teachers/newly trained teachers should have mentors to guide them and the experience teachers should update themselves with modern pedagogy, involve in good networking to share ideas that are relevant to teaching and students' academic achievement. The finding further agrees with Mapulanga et al., (2022) who conducted a study on perceived enacted PCK in Biology in selected senior secondary schools and proposed that teachers should use professional development to enhance their pedagogical content knowledge. The finding is also consistent with Kola and Sunday (2017) who recommended that government should organize workshops, seminars, conferences regularly for teachers in order to improve their pedagogical content knowledge. Teachers should avail themselves during district, regional and national conferences, workshops, webinars, seminars on professional development in order to help them improve their pedagogical content knowledge. The finding further collaborates well with the finding of Moh'd et al.; (2021) who pointed that more in-service training should be organize for teachers in order to raise their pedagogical content knowledge level which will help them improve their teaching. Integrated science teachers at the basic level should also take it upon themselves and invest in their own professional development by participating in courses. Seminars and conferences that are capable of helping them to improve their PCK since Ghana Education Service and Ministry of Education may not have the financial muscles to organize in-service training for them regularly.

VI. EDUCATIONAL IMPLICATIONS AND PRACTICE

This study will be very vital to teachers across the globe since teaching and learning takes place in every part of the world. The study will also be useful to educators, district, municipal and regional directors of education and institutions with accreditation to train teachers for the nations, continent and the globe at large. The study will create awareness on the importance of professional development which will trigger teachers at all levels of education to upgrade themselves in order to be abreast with issues in the teaching field that enhances effective teaching and learning. This study will motivate Ghana Education Service and Ministry of Education to periodically organize seminars, workshops, conferences and professional development courses for teachers from the basic level to tertiary. This study will further help newly trained teachers to avail themselves for mentorship by season or experience teachers.

VII. CONCLUSION

The study examined basic school integrated science teachers' pedagogical content knowledge and its usefulness in their lessons delivery and measures or policies that can be implemented to help improve their pedagogical content knowledge. The study found that teachers pedagogical content knowledge supports them to deliver their lessons effectively. The responses of the participants proved that teachers pedagogical content knowledge cannot be ignore as far as teaching is concern. The responses of the integrated science teachers indicated that knowledge of the subject matter and pedagogy is the main weapon of the instructor in the class. The study also found that integrated science teachers pedagogical content knowledge can be improve through workshops, seminars and conferences, individual and collaborative research, professional upgrading, observation visits to other schools, peer observation and mentoring. This therefore, call for the need for teachers to constantly upgrade themselves academically and professionally in order to make them effective in the teaching field.

VIII. RECOMMENDATIONS

The researchers came up with the following recommendations based on the findings of the study.

- ✓ In-service training should be organized frequently for integrated science teachers at the basic level.
- ✓ The government, Ghana Education Service and the Ministry of Education should increase the quota for study leave with pay for integrated science teachers at the basic level to enable them upgrade professionally and academically.
- ✓ The newly trained teachers (semi-finished product) should be given mentorship by the experience teachers. The newly posted integrated science teachers should be under the guidance of the well versed or season integrated science teachers during their first three years in the teaching field.
- ✓ Institutions mandated to train teachers for the nation should place more emphases on subject matter and modern instructional strategies in order to equip integrated science teachers with high level of pedagogical content knowledge.

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Cite this article as :

Ezekiel Akotuko Ayimbila, Joshua Awuni, Diana Akantagriwon, "Basic School Integrated Science Teachers' Pedagogical Content Knowledge and Its Usefulness in Their Lessons Delivery", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 10 Issue 1, pp. 423-433, January-February 2023. Available at doi : https://doi.org/10.32628/IJSRST2310133
Journal URL : https://ijsrst.com/IJSRST2310133