UNIVERSITY OF EDUCATION, WINNEBA

ASSESSING SCIENCE TUTORS' KNOWLEDGE AND USE OF PEDAGOGIES IN THE NEW B. ED CURRICULUM FOR COLLEGES OF EDUCATION IN GHANA

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DECLARATION

Student's Declaration

I, ABUKARI WASILA, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: ……

DATE: ……

Supervisor's Declaration

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: Dr Ernest I. D. Ngman-Wara

SIGNATURE: ……

DATE: …….

DEDICATION

To my husband, children and entire family.

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ABSTRACT

The study examined science tutors' knowledge and use of the pedagogies in the new B.Ed. Curriculum for Colleges of Education in Ghana, with particular reference to Science Colleges of Education in Northern Region. This was done to determine science tutors' knowledge level of the recommended pedagogies, the extent to which they use the recommended pedagogies, and factors that affect their use of the recommended pedagogies in the new B.Ed. Curriculum in their classrooms. The case study design was adopted for study where quantitative and qualitative data collection instruments such as questionnaires, interview and observation were used to collect data for analysis**.** The purposive and convenient sampling techniques were used. A sample of 25 participants made of 23 males and 2 females was used for the study. The SPSS and the Microsoft Excel 2007 were the statistical packages used to analyse the data for the study. The data was also analysed using descriptive statistics and percentages. The study revealed that, the tutors' knowledge on the recommended pedagogies in the new B.Ed. Curriculum was adequate. The tutors were also able to use recommended pedagogies in the new B.Ed. Curriculum to a moderate extent in science teaching at the E. P. College of Education, Bimbilla and Tamale College of Education. Besides motivation, inadequate teaching resources such as projectors, laboratory equipment, regents, furniture and space were identified as key factors that affect science tutors use of the recommended pedagogies. It was recommended that the appraisal instruments for science tutors by the Quality Assurance Units of the Colleges of Education should include extensive information on the usage of the recommended pedagogies by tutors. It was also recommended to the College Management/leadership to ensure that critical resources are provided adequately and on time to enhance the science tutors' effective use of the recommended pedagogies. Also, the assessment strategies used by the Colleges of Education, especially the end of semester examination, should be aligned with the recommended pedagogies that tutors use in their classroom teaching. In order to motivate science tutors to commit themselves more to the use of the recommended pedagogies in the classroom, it was recommended that, innovative strategies such as awarding tutors who use pedagogies in the new B.Ed. Curriculum frequently and effectively be set up in the Colleges.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter covers the background to the study, statement of the problem, purpose of the study, research objectives and questions, significance of the study, limitations and delimitations of the study. The chapter also provided and defined abbreviations and terms used in the study. It ends with the organisation of the study.

1.1 Background to the Study

As far as Education is concerned, the most important issue in recent years with regard to improving learning outcomes is about improving the quality of the teaching workforce. There are also concerns about attracting high-achieving and well-motivated successful Senior High School graduates into teacher education programmes. This justifies the on-going national efforts to transform and upgrade teacher educational programmes in Ghana to produce high quality teachers for the country. The Government of Ghana therefore instituted a four-year programme called Transforming Teacher Education and Learning (T-TEL) with financial support up to £17 million from the UK Government to transform the Pre-Service Teacher Education in Ghana in order to improve the quality of teaching and learning in the country (Transforming Teacher Education and Learning (T-TEL, 2017).

T-TEL therefore seeks to initiate a reform programme to instigate effective professional development for College of Education Tutors and Pre-Service Teachers with the view of developing professional teachers who are well-equipped with knowledge, skills, and the disposition to learn, and who will in turn, guide their pupils to achieve the learning outcomes of the national curriculum for basic education. The

intended outcome of the programme is the development of beginning teachers who will demonstrate interactive, learner-centred pedagogies, gender-sensitive measures and inclusive strategies in their future classrooms. That is, the pre-service teachers who will be well versed and be able to implement the school curriculum and assessment (T-TEL, 2017).

In view of the ongoing reforms in Teacher Education in Ghana, Professional Development Sessions (PDS) have been instituted for Tutors of Colleges of Education. The brain behind this Professional Development Programme is to equip and improve Tutors' pedagogical skills in the new B Ed curriculum which will enable them appreciate the National Teachers Standards (NTS) and National Teacher Education Curriculum Framework (NTECF) better. The programme was designed to bring about changes in the tutors' behaviour and performance, as well as prepare them for effective delivery of the 4-year Bachelor of Education (B. Ed) Curriculum and sharpen the teaching skills of the Pre-Service Teachers (T-TEL, 2017). This places a higher responsibility on the Tutors in Colleges of Education to acquire and use the requisite knowledge and skills of interactive and student-centred instructional pedagogies in training their students. This is because educational innovations and reforms demand changes in classroom practices (Tishkovskaya & Lancaster, 2012). Pre-Service Teachers who are being trained by the College Tutors have the obligation to teach using the learner-centred pedagogies as they acquired in their training.

T-TEL thus, provides support for college-based Professional Development of the Tutors. As a consequence, weekly professional development sessions were instituted and organized in every semester to improve Tutors knowledge and use of pedagogies for effective teaching practice. As part of the techniques of improving performance

under the programme, professional development has been focused on classroom practices such as questioning, group work, use of teaching and learning materials, collaboration, the use of gender and inclusive strategies and so on - which are treated thematically for a semester and are being facilitated by specially trained College Tutors appointed as PDCs (Waitoller, & Artiles, 2013).

1.2 Statement of the Problem

Many studies have been conducted on pedagogy over the years. For example (Loughran, 2013; Cobern, Schuster, Adams, Skjold, Muğaloğlu, Bentz & Sparks, 2014; Korthagen, 2016) have all carried out studies on pedagogy sharing different perspectives. The focus of these studies and many others were largely on what pedagogies are as against an assessment of the usage of the various pedagogies in teaching by science tutors in the classroom. Besides, the reforms in teacher education in Ghana before 2018 all yielded insignificant positive effects. The studies so far have provided insufficient information on how tutors are putting their knowledge of pedagogies into use in the classroom as recommended in the new B. Ed Curriculum.

Studies on the New B. Ed Curriculum for Colleges of Education in Ghana as from 2018 for example, have not provided enough information on tutors‘ use of recommended pedagogies in science classrooms. There is therefore a gap in the studies of pedagogies and tutors putting pedagogies into use in the classroom as suggested in the new B.Ed. Curriculum. This study therefore looks at science tutors‘ use of the recommended pedagogies in the New B.Ed. Curriculum to provide information for researchers, curriculum developers and management of Colleges of Education in Ghana for purposes of a review and as a reference material for college science tutors to adjust their teaching in the classroom.

1.3 Purpose of the Study

The purpose of this study was to assess tutors‘ knowledge and use of pedagogies in the new B. Ed Curriculum in teaching science by tutors at the Colleges of Education in Ghana.

1.4 Objectives of the Study

The objectives of the study were to:

1. determine tutors‘ knowledge level about the recommended pedagogies in the new B. Ed Curriculum in science teaching.
2. assess the extent to which tutors use the recommended pedagogies in the new B.Ed. curriculum in their science classrooms.
3. identify factors that affect science tutors‘ use of the recommended pedagogies in the new B.Ed. Curriculum.

1.5 Research Questions

The study was guided by the following questions:

1. What is the level of science tutors‘ knowledge about the recommended pedagogies in the new B.Ed. Curriculum?
2. To what extent do science tutors use the recommended pedagogies in the New B.Ed. Curriculum in their teaching practices?
3. What factors affect science tutors‘ use of the recommended pedagogies in the new B.Ed. Curriculum?

1.6 Significance of the Study

The study would provide information on science tutors knowledge and use of pedagogies in the new B.Ed. Curriculum in their classroom tutoring. This would

enable College Management/Authorities to strategise and to address such policy implementation gaps involving tutors' knowledge and use of the recommended pedagogies in the new B. Ed curriculum.

The study also sought to be of benefit to the making of policies in the College and more especially T-TEL on the success or otherwise of the use of recommended pedagogies in the new B. Ed Curriculum acquired by tutors through professional development which have been instituted as part of the reforms for teacher education in Ghana.

New practices are likely to be abandoned if there are no evidence of its impact. Hence, the study would provide feedback to the developers of the curriculum on the use and impact of the pedagogies which are critical for the realisation of effective implementation of the new B.Ed. Curriculum effort. The feedback may be useful for future review of the curriculum.

The results from the study would also serve as feedback to the science tutors as they reflect on their pedagogical practices in their science classrooms during professional development sessions. These reflections would improve the quality the tutors' use of the recommended pedagogies in their science classrooms.

1.7 Delimitations

The study was delimited in scope to science tutors who teach science courses in the Colleges of Education in the Northern Region of Ghana. Tutors might be involved in the use of other pedagogies but this study specifically targeted the knowledge and use of pedagogies recommended in the new B.Ed. Curriculum at the Colleges of Education in the Northern Region.

1.8 Limitations

The data collected and used in the study was cross-sectional in nature in which alternative causal impact could not be ruled out. Also, it was based on the tutors' self-report on their knowledge and use of the recommended pedagogies in the new B.Ed. Curriculum. As a result, the data gathered in the study may not represent the actual practice as the tutors could exaggerate their knowledge and use of the recommended pedagogies in the new B.Ed. Curriculum in their classroom teaching practices.

Also, the sample size of participants for the study was not large enough for generalization of the findings as in the case of typical quantitative study, since this is case study and the findings cannot be generalised to the other 46 Colleges of Education in Ghana. However, the information gathered is detailed enough to provide readers with the necessary information regarding the subject matter under study. Besides, to limit the impact of self-report biases on the results, the researcher carried out lesson observations on five tutors on the use of the recommended pedagogies by the science tutors in their classrooms.

In addition, the number of tutors who had challenges in using the recommended pedagogies in the various teaching experience categories could not be ascertained because the data collection instrument was not segregated on that basis. It is therefore difficult to segregate findings in respect of teaching experiences of the tutors from the data.

1.9 Definition of Terms

Science tutor or teacher were used interchangeably to an instructor who taught either elective or core science courses in the college at the time of the study.

Professional Development Coordinators are experienced tutors from colleges of education selected and trained to serve as facilitators of the weekly professional development sessions organised by departments.

1.10 Abbreviations

CPD: Continuous Professional Development

E.P: Evangelical Presbyterian

PDCs: Professional Development Coordinators

1.11 Organisation of the Study

The report of the study was organised into five chapters. The first chapter which is an introduction of the study covered the background to the study, statement of the problem, purpose of the study, research questions, the significance of the study, the delimitation of the study, limitations of the study, and definition of terms.

The second chapter delved into review of literature related to the study. It covered the theoretical and conceptual frameworks together with the review of related empirical studies. Chapter three of the study focused on the methods for the study which covered the research design, the population, the sampling procedures, the instrument to be used, data collection procedure and the data processing and analysis. The fourth chapter presented and discussed the results of the study. The fifth, and final chapter provided the summary, conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter of the study focuses on assessing science tutors‘ knowledge and use of pedagogies in the new B. Ed Curriculum at the Colleges of Education. Existing literature which is deemed relevant and relating to the topic was reviewed using electronic databases, key journals, websites, articles and advice from key contacts. The purposes of the literature review are to share with the reader the results of other studies that are closely related to the one being undertaken and also to relate the study to the larger ongoing dialogue in the literature, filling in gaps and extending prior studies (Rozas & Klein, 2010). The literature was reviewed under the following headings:

2.1 New B.Ed. Curriculum for Colleges of Education

2.2 Theoretical framework

Related Literature

2.3 Science Tutors‘ knowledge about the recommended pedagogies in the B.Ed. Curriculum

2.4 Science Tutors use of the recommended pedagogies in their classroom practices

2.5 Factors that affect Science Tutors‘ use of the recommended pedagogies in the implementation of new B.Ed. Curriculum

2.6 Conceptual Framework underpinning the study

2.1 New B.Ed. Curriculum for Colleges of Education

The key institutions that trained teachers for pre-tertiary schools (Kindergarten, Primary and Junior High Schools) were the Teacher Training Colleges now designated Colleges of Education (CoE). The pattern of the development had been in response to national demands in general and changes at the basic school level in particular. Previously, the colleges had run different programmes in response to the needs and circumstances of the moment, and tutors have been required to undertake more institutional training to upgrade their knowledge. Consequently, the colleges as asserted by Adu-Yeboah and Kwaah (2018) have run programmes that led to the various types of teacher qualifications:

i. Four-year certificate _A' for middle school leavers
ii. Two-year certificate _B' for middle school leavers
iii. Two-year certificate _A' programme for certificate _B' holders
iv. Two-year certificate _A' programme for secondary school leavers
v. Three-year certificate _A' for secondary school leavers
vi. Three-year six-semester Diploma in Basic Education (DBE)

These programmes faded out at different times. For the past 20 years, there had been several minor reforms in the Initial Teacher Education in Ghana, which had very minute effect on learning outcomes of learners especially at the basic level of education. In view of this, a policy for Initial Teacher Education Reform was approved by Cabinet in 2018 which led to the introduction of the 4-year B.Ed. programme.

2.1.1 The Foundations of the B.Ed. Curriculum

There are a number of distinctive features which informed the B.Ed., and provided the foundations of the curriculum. The B Ed curriculum has five features namely:

i. A value-driven curriculum: the writing of the NTECF and of the curriculum was driven by the nation‘s core values of honesty, integrity, creativity and responsible citizenship, and with the intent of achieving SDG4: inclusive, equitable quality education and lifelong learning for all, and by the vision for a good teacher as set out in the NTS.

ii. A concurrent curriculum: Student teachers‘ subject content knowledge, pedagogy and assessment approaches and practical teaching skills are developed alongside each other.

iii. An integrated curriculum: preparing student teachers to: meet the requirements of the NTECF; be assessed against the NTS and to be able to teach the Basic School Curriculum. Cross-cutting issues connect the different areas of study, cutting across subject-matter lines and emphasizing unifying concepts. The integration focuses attention on making connections for student teachers, allowing them to engage in relevant, meaningful activities directed at developing the skills, knowledge and understanding of an effective teacher.

iv. A developmental curriculum: student teachers will progress through four levels: beginning, developing, embedding and extending teaching. Each level has its own set of expectations. Student teachers‘ progress, learning and skills through each subject or learning area will be mapped out across the four years.

v. Interactive pedagogy: preservice teachers need to be prepared to base the pedagogy they use on the social constructivist view, which sees teacher

education as the co-construction of knowledge. They will be able to use differentiated instruction and assessment strategies.

According to Abudulai (2021), the Four-Year Bachelor of Education Degree (B.Ed.) is fully aligned with the expectations, principles and practices set out in the National Teacher Education Curriculum Framework (NTECF).

The vision of the 4-year B.Ed. programme is to prepare new teachers to become effective, engaging and inspirational to their learners in the basic education (Caruth, 2018). It is also to prepare new teachers who are fully equipped to teach the basic school curriculum in order to improve the learning outcomes and life chances of all learners as set out in the National Teachers' Standards (NTS). The National Teacher Education Curriculum Framework (NTECF) provides the details necessary for the development of the Initial Teacher Education curriculum. The aims of the new B.Ed. Curriculum are: to instil in the new teachers the nation's core values of honesty, integrity, creativity and responsible citizenship and to achieve inclusive, equitable, high-quality education for all learners in line with Sustainable Development Goal (SDG) Four (4). It is also to produce highly qualified and skilful manpower for the nation in line with National Teachers' Standards (NTS), which set out minimum values, skills, knowledge and attributes required of a good teacher.

The 4-year B.Ed. Curriculum is an eight semester-curriculum which consists of three distinct programmes: Early Grade Education (Kindergarten to Primary Three), Upper Primary Education (Primary Four to Six) and Junior High School Education. Each of the programmes was written to adhere to the Initial Teacher Education curriculum structure set out in the NTECF. The curriculum is built on four pillars defined by the

NTECF which are set out to provide essential knowledge, skills and understanding necessary for effective teaching. The pillars are described below:

1. Subject and curriculum knowledge: secure, subject-specific content and pedagogic knowledge are the key to being able to teach the school curriculum including: subject knowledge for teaching; progress in learning in subjects; misconceptions, potential contextual barriers to learning and curriculum studies. All school curriculum subjects are addressed and made specific to each specialism.
2. Literacy Studies (Ghanaian Languages and English), including Early Grade Literacy in L1 and L2. As language is the key to enabling children to access the curriculum, this learning area is a pillar in its own right.
3. Pedagogic Knowledge, including: general pedagogic knowledge, assessment strategies, introduction to and development of cross cutting issues, education studies, preparation for supported teaching in school, classroom enquiry and research, Inclusion and equity, SEN and ICT.
4. Supported teaching in school: student teachers will spend 30% of their training in the field. For the KG-P3 and P4-6 specialisms this training period will be spent in schools with the support of mentors. For TVET this part of the training will be divided between TVET schools and industry with the support of mentors. Stobaugh and Tassell (2011) pointed that, mentors need to assess student teachers on the development of competencies and skills set out in the National Teachers‘ Standards.

The curriculum has specialisation options which first year preservice teachers are expected to select one of three programmes. These are the Early grade (KG-P3); Upper Primary (P4-6) and Junior High School. This is intended to ensure that

preservice teachers acquire in-depth content and pedagogical knowledge in their specialised courses to teach effectively in the classrooms.

Fig. 1 shows the model of progress for student teachers across the four years. Each year of the curriculum builds on the outcomes of the previous year. This is achieved through: college-based training, school-based experience and training, course work, practical work, work-based learning and independent study.

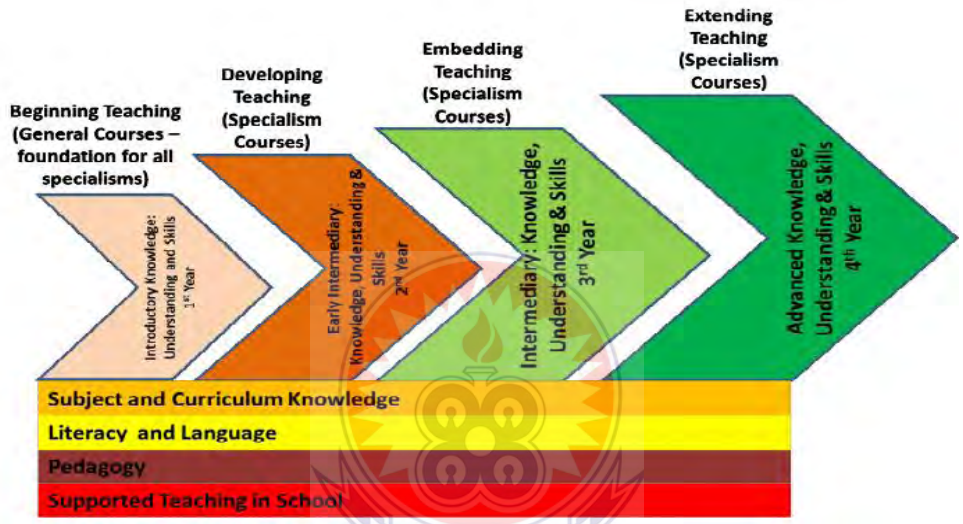

Fig. 1: Model of Progress of Preservice Teachers Across the Four Years

Year one is designated as beginning teaching which provides support to student teachers for the transition from Senior High School to college and recognises that many student teachers will have come from school level education and from a wide range of backgrounds and experience. It introduces the key principles and practises of the subjects and learning areas and supported teaching in the school within the wider curriculum thereby ensuring that student teachers can locate their specialisms.

Year two is designated as developing teaching. The student teachers are required to select one of the three specialism programmes. However, key features from year one relevant to each specialism continue to be developed. The second year prepares

student teachers to identify and assess weaknesses and barriers to learning for basic school pupils and carry out small-scale action research under the guidance of mentors. The year three of the programme is described as embedding teaching. Here the student teachers will continue to build skills, knowledge and understanding in their chosen specialism. They will co-plan and co-teach groups of learners and whole classes; carry out small scale classroom enquiries and provide evidence of working towards meeting the NTS. The year three also includes preparation for year four, final supported teaching in school (internship) and for significant classroom-based enquiry and action research projects.

In the final year (Year 4) is describe as extended teaching where student teachers go on internship in basic schools and come back to continue course work. The student teachers will: plan, teach and assess their learners independently and with increasing consistency. They are expected to exhibit the ethical codes of conduct, values and attitudes required of a teacher; carry out extensive action research projects and provide evidence of meeting the National Teachers' Standards in full.

2.1.2 Assessment of preservice teachers

The rational for assessment is to determine whether or not the goals of education are being met. On this score, the assessment carried out on the new B.Ed. Curriculum was to gather relevant information about student performance, determine instructional needs of the students, make decisions about grades, placement, advancement and the curriculum. Assessment also helps to determine student interests to make judgments about their learning process. Student teachers must be assessed against the NTS in a way that has a positive impact on their progress towards being good teachers. This is particularly relevant for supported teaching in school components. Student teachers must be realistically and fairly assessed against the Standards in accordance with what

can be reasonably expected of teachers still learning to teach. This calls for an assessment of student teachers‘ creative and innovative skills appropriately in the context and circumstances they are in and for the level of learners they are to teach, for example, for very young children in pre-school, or for young people needing specialist knowledge at Junior High School. It is important for those assessing student teachers and student teachers themselves must know the Standards, use them as an exemplification of what a _goodteacher‘ looks like in Ghana, and as the key reference point in their assessment. Content and learning outcomes must support progress to meeting the Teachers‘ Standards.

It is equally important to use the feedback from assessments to provide information to student teachers on how they can improve and identify targets. In this wise, assessment should: include the use of a range of appropriate measures; take place throughout the course; have clearly specified progression stages and include assessment of, for and as learning. For the assessment to be comprehensive, there should be consistency in assessments across the curriculum and at each level. This should involve: tracking the growth of competence for individual student teachers against the NTS, tracking group performance year after year and evaluating impact of improvements, building programme coherence around a common assessment language, providing NAB with information about curriculum quality. All assessments must be underpinned by an awareness of inclusion and equity of opportunity, both in relation to preservice teachers' own learning experience and to the experience of their learners.

To cover the relevant areas of the subject matter for the curriculum, the suggested % weightings for assessments across the three programmes are: 30% Supported

Teaching in School, 40% Course work, including: assignments, presentations, projects, 30% Examination, including quizzes. Assessment components should be limited to three per three-credit course regardless of the number of subjects or learning areas involved, to avoid assessment overload. Any single course assessment component may encompass assessment for, of and as learning. All assessment components must have related aspects of NTS identified.

To ensure the effectiveness of the assessment, the components should exemplify student teachers‘ ability to address inclusion and how equity is being developed. The assessment components should exemplify how core and transferable skills, global competencies, from the new B.Ed. Curriculum are being developed and addressed.

2.1.2.1 Assessment strategies

All assessments must be structured to provide evidence of a student teacher‘s progress against the Standards and contribute to their development as a teacher, reflecting the strategies they could use when assessing learners (Ismail, et. al. 2017). Essential to this is the production of a professional teaching portfolio. The portfolio is to be organised according to the three domains of the Teachers‘ Standards. Evidence from college-based learning will be in the form of assignments, feedback on group and individual presentations, recordings of performances, examination results and lecture notes. Evidence from in-school learning will be from lesson plans, study notes, resources, assessment records, learner exercise books, photographs, action research and case study, evaluations from tutors and mentors, testimonials, minutes of meetings and any notes from CPD courses, and evidence collected by the student teacher over time.

For critical reflective practice, the professional portfolio provides the initial point for the continued development of the teacher through their Induction year and for subsequent years. By the end of their training, preservice teachers through attaining the NTS, will demonstrate the academic attributes associated with a graduate of a professional teaching degree.

2.1.3 Recommended Pedagogies for the B.Ed. Curriculum

Different types of pedagogies are used in the B.Ed. Curriculum for Colleges of Education in Ghana. Each of the pedagogies is not single-handedly used throughout lesson delivery. A blend of the pedagogies is recommended for use by tutors for teaching science by the curriculum developers to make lesson delivery comprehensive. The recommended pedagogies in the B.Ed. curriculum included constructive, collaborative, reflective, integrative and inquiry-based learning. This is in line with Parker and Thomsen (2019) conclusion, where they grouped pedagogies into constructive, collaborative, reflective, integrative and inquiry-based learning pedagogies. The new B.Ed. curriculum recommends the use of the constructive pedagogical approach to teaching by tutors. According to Solvie and Kloek (2007), the constructive pedagogy of teaching is where student teachers are made to interact with material presented to them and construct meanings as they reflect on the materials provided, thereby creating knowledge, not simply acquiring it.

In line with this knowledge acquisition approach, the new B.Ed. curriculum recommends the use of strategies such as games, storytelling, songs, modelling, gender responsive strategies and use of teaching and learning resources (TLR s) by science tutors to make their student teachers active participants in their classrooms.

Another pedagogical approach adopted for the new B.Ed. Curriculum is the collaborative pedagogy. Collaborative pedagogy according to Redes (2016) is an umbrella term for a variety of educational approaches involved in joint intellectual effort by student teachers, or students and tutors together. The recommended activities vary but mostly centre on student's exploration or application of the course material. Using the pedagogy, learning is naturally a social act in which participants talk among themselves. It is required that science tutors use online - collaborative learning, jigsaw method, think- pair- share, group work and peer teaching to guide the student teachers in the classrooms.

Reflective pedagogy is also extensively used to guide science tutors in their teaching as a requirement of the new B.Ed. Curriculum for colleges of education in Ghana. Reflective teaching and learning forms part of critical pedagogy. Reflection has to do what the teacher and learners do in the classroom, thinking about why they do it and how it works. This is a process of self-evaluation, self-reflection, as well as an assessment which uses presentation, paper writing reports, or Journals according to Ottesen (2007). It is a result of knowledge derived from the studies on reflective pedagogies that tutors in Colleges of Education in Ghana are required to assess their student teachers based on the NTS. They are expected to use reflective practices, models presentation for assessment, assignments, self and peer strategies to assess their student teachers as recommended in the B.Ed. Curriculum.

The use of integrative pedagogies is also highly recommended by the B.Ed. Curriculum. The goal of integrative pedagogy according to Peyser, Gerard, and Roegiers (2006) is to enable the learner to master those situations they need to succeed in the larger society.

Peyser, et. al. (2006) opines that integrative pedagogy has the objectives of making sense of the learning process, differentiating matters by relevance, applying the learning to practical situations and associating the learned elements. Based on this, the B.Ed. curriculum recommend strategies such as gender responsivity, practicing inclusivity, use of motivational techniques, managing the learning environment, identifying and clarifying possible misconceptions of student teachers, aligning performance indicators, teaching and assessment.

Inquiry-based learning or pedagogies requires more than simply answering questions or getting a right answer. It espouses investigation, exploration, search, quest, research, pursuit, and study. For Whitworth, Maeng and Bell (2013), inquiry is an important pedagogical approach in teaching science. Enquiry-based pedagogy has been significantly improved digitally to allow the learning process to be supported by electronic. Sari, Sen, and Kirindi, (2020) noted that educators play an active role throughout the process of teaching and learning using enquiry-based pedagogy. Sari, et. al., (2020) further asserted that to achieve the desired outcomes using this approach, strategies such as simulation, video, demonstration, experiment, field study, project work are highly recommended. The new B.Ed. Curriculum equally emphasise the use of inquiring-based approaches by science tutors as it suggested strategies such as use multimedia, field trips to identify important scientific scenes, use of peer point presentation, use of e-Learning opportunities, talk for leaning, inquiry learning and pyramid discussions among others.

2.1.4 Credit Weightings of the Curriculum

In developing the curriculum, care has been taken to avoid preservice teacher overload. The content has been written with the learner, the preservice teacher, in

mind, and specifically what is realistic in terms of the time available and what is achievable at each phase of training in order to enable them to meet the NTS in full. The credit weightings in the Curriculum are thoroughly aligned to the proportion of time allocated to each pillar and for each specialism in the NTECF.

NAB guidance was followed in relation to the number of credits per year and the rubric to courses being allocated credits. The total number of credits for a semester is either 21 or 24, except year four. Each three-credit course is equivalent to three hours face-to-face teaching or six hours practical or a combination of the two per week. The ultimate interpretation of credit hours is at each institution's discretion but it is essential to avoid overloading student teachers (Zhang, Gossett, Simpson, & Davis, 2019).

In year four, semester one is used for the supported teaching in school internship. Project work starts in year four semester one and it is expected to be completed in semester two. Student teachers are expected to present evidence of meeting the NTS during Post STS internship seminars in semester two based on their professional portfolios.

2.2 Theoretical Framework

This study is situated within three main theorical perspectives. These are Albert Bandura's Theory of self-efficacy, the constructivist theory and other theories of pedagogy.

2.2.1 Albert Bandura's Self-Efficacy Theory

Bandura's theory of self-efficacy postulates that efficacy is flexible during the early years of training. The contention is that different modes of influence alter coping

behaviour by creating and strengthening expectations of personal efficacy. Tutors are required to use different teaching and learning strategies, techniques or pedagogies to create rich learning environment for preservice teachers and to bring about improved learning outcomes of basic school pupils (Subban & Round, 2015). The acquisition of the right skills and attitudes of preservice teachers has far- reaching implications for their performance in the long run. The theory of self-efficacy makes it obligatory for teachers to provide enriching activities and environments to develop the potentialities of their students and shield their negative self-conceptions to produce the change that they desire (Appova, & Arbaugh, 2018).

The researcher shares in the conviction of Appoya and Arbaugh that those who are responsible for teachers training are required to know and use the right teaching pedagogies in the classroom. This will provide the right atmosphere for the tutors to learn how to teach effectively. It is in the light of this that professional development sessions are run for tutors in Colleges of Education to improve their teaching skills in line with the recommended pedagogies for effective implementation of the B.Ed. programme. This provides an opportunity for the science tutors in colleges of education to acquire and use the right pedagogies in the implementation of New B. Ed Curriculum.

2.2.2 Constructivists Theory

Constructivism refers to bodies of knowledge as human constructs, built up over time and influenced by politics, ideologies, values, and power structures that work to preserve this knowledge. In this sense, constructivism refers to the construction of knowledge, as well as knowledge about the external world. According to Gordon (2009), the use of the constructivists pedagogy for teaching requires the instructor in

the classroom to attend to the learners taking into account their past experiences that shaped their thinking over time.

Such experiences in the view of Drexler (2010) are influenced by historical and cultural practices but are also influenced and reshaped by the social relations and social conditions present in the classroom. Constructivist learning environments are established with the belief that learner control of learning or autonomy is important in the learning process. The instructor serves as a coach or an expert guide leading and scaffolding students' learning in their construction of knowledge. Other factors in the learning environment such as social relations and identities equally have a bearing on the learners (Lefstein, Vedder-Weiss, Tabak, & Segal, 2018).

Cakir (2008) viewed constructivist approach allows learners to be active in the process of constructing meaning and knowledge rather than passively receiving information. It fosters critical thinking and provides learners with a learning environment that helps them make connections with their learnings. In the process of constructing knowledge teachers have critical roles to play. These include: to influence, or create motivating conditions for students, take responsibility for creating problem situations, foster acquisition and retrieval of prior knowledge, create the process of learning not the product of learning. In the words of Solvie and Kloek (2007), construction of knowledge is supported as preservice teachers engage with material to make connections to prior knowledge, view material from multiple perspectives, and add to an existing schema.

These theorical perspectives shared by Gordon, (2009); Drexler, (2010); Lefstein, et. al, (2018); Cakir, (2008); Solvie and Kloek, (2007) are reflected in the new B.Ed. Curriculum for Colleges of Education as the curriculum completely departs from the

teacher-centred approaches used in the past and recommends the use of innovative and learner-centred teaching strategies such as creating learner friendly environment, use of appropriate seating arrangements, role plays and use of starters/energisers to begin lessons and discuss course manuals with students teachers among others.

2.2.3 Other theories of pedagogy

By pedagogies, the researcher is referring to an all-encompassing term that is concerned with what the instructors do to influence the learning of others. Chow, Teo-Koh, Tan, Button, Tan, Kapur and Choo (2020) assert that pedagogy develops from a range of factors including theories and research evidence, political drivers, evidence from practice, individual and group reflection, educator's experience and expertise, community expectations and requirements. In other words, the professional experience of the individuals and personal understandings are viewed as critical factors that are taken into contemplation in understanding the meaning and significance of pedagogy.

According to Bernstein (2000), pedagogy is a sustained process whereby somebody acquires new forms or develops existing forms of conduct, knowledge, practice and criteria from somebody or something deemed to be an appropriate provider and evaluator. Pedagogy, which is mostly referred to as methodology, emerged as one focal area with significant implication on school activities, and ultimately school outcomes which the curriculum must emphasize.

Curriculum Reform Study Research report of T-TEL (2018) quoted participants that, methodology helps in the overall stock knowledge including the essential skills of the teachers needed to facilitate and foster learning and improve intended school outcomes. The implication is that the curriculum should consider exposing preservice

teachers to various contemporary teaching skills and devising activity-based learning experiences for preservice teachers such as presentations, cooperative learning etc. The instructors need to focus upon curriculum methods (DeLuca & Bellara, 2013; Grossman, Hammerness & McDonald, 2009). Grossman, et. al. (2009) again asserts that, at all levels of education, teachers need to bring about improvements in the curriculum methods.

There are different types of pedagogies used in the education enterprise. According to Ramakrishna and Devi (2020) the different types of pedagogies are social pedagogy, critical pedagogy, culturally-responsive pedagogy and Socratic pedagogy. Critical elements and knowledge in these pedagogies have been harmonised into the new B.Ed. Curriculum for Colleges of Education in Ghana to make it very comprehensive and responsive to the needs of tutors and student teachers. These pedagogies are explained in the following paragraphs.

Social pedagogy emphasises the fact that socialization is an important aspect of education. People need to develop social skills in order to enrich their living conditions in an efficacious manner and acquire better livelihoods opportunities. This view is supported by Kkalil and Elkhider, (2016). Leaners need to form cordial terms and relationships with other individuals to augment their educational skills. In higher educational institutions such as Colleges of Education in Ghana, that is, in the pursuance of bachelors, masters and doctoral programs, the students need to work on group projects, hence, social pedagogy is the pedagogy that is put into practice to a major extent. In the implementation of social pedagogy, individuals need to take into account various factors (Slovenko & Thompson, 2016). These are, communicating in a respectful manner, treating others with courtesy and developing kind-heartedness

and generosity. Through the reinforcement of social pedagogy, the students are able to obtain support and obtain assistance from their fellow students as well as instructors in the achievement of their academic goals (Blatchford, Kutnick, Baines, & Galton, 2003).

Social pedagogy is similar to integrative pedagogy from which knowledge was drawn to develop the New B. Ed Curriculum. Similarly, critical pedagogy puts emphasis on critical theories. Critical theories are inspired by radical philosophies which makes an attempt to help the students to question, challenge the domination and undermine the beliefs and practices that are alleged to dominate (Wortmann, 2020). The researcher shares notion that the primary goal of this pedagogy is to challenge the student teachers on regular basis for them to question their own thoughts, ideas, beliefs, strategies, practices and to think critically. Tutors in Colleges of Education put into operation critical pedagogies by guiding the preservice teachers to acquire deeper understanding of academic concepts practically (Farrow, 2017).

The New B.Ed. Curriculum for Colleges of Education in Ghana equally encompasses culturally-responsive ideals which has been identified as another important type of pedagogy. For culturally-responsive pedagogy, the students in educational institutions are different in terms of cultures.

Anderson and Campbell (2010) explained that, in a culturally diverse society like Ghana, three functional dimensions which are critical for the education of children are, institutional, personal and instructional. These factors are utilized together to recognize and respond to the cultural differences among students.

When the cultural differences are recognized among students, the approaches and methods of learning are put into practice for their benefit as buttressed by Mellom, Straubhaar, Balderas, Ariail, and Portes (2018). Alsubaie, (2015) opines that, to put a culturally responsive pedagogy into practice, an educator must be willing to accept the different needs of a multicultural classroom and create a comfortable environment for all students. In other words, the classroom environmental conditions are formed in such a manner taking into account the diverse needs and requirements of the students. This theory is grounded in the use of differentiated teaching and learning which is highly recommended in the New B.Ed. Curriculum. Students belonging to diverse cultures form the viewpoint that the pedagogical methods acknowledge their cultures and that motivates them towards learning and make them form constructive viewpoints on various aspects of the system of education (Eccles & Roeser, 2011). According to Chibueze and Okoye (2021), inquiry- based pedagogy has a bearing on culturally responsive pedagogy. The culturally responsive pedagogy is operationalised in the B.Ed. curriculum as strategies such as use of songs, roleplay, games, gender responsive measures, use of non-discrimination, storytelling which are based on the progressive cultural values of the community are stressed for use by tutors.

Socratic pedagogy according to Boa, Wattanatorn, and Tagong (2018), follows a philosophical approach. It involves a process, whereby the students can develop their social and intellectual skills. The students do not merely get enrolled in educational institutions to pursue educational programmes to enrich their career prospects but to also develop other skills and abilities.

This is necessary to sustain their living conditions in a satisfactory manner. The important skills which the individuals need to develop are: communication, decision

making, presentation, innovativeness, critical thinking, analytical, problem solving, technical, time management, personal and professional skills (Bacha, 2002). The new Bed curriculum exemplifies the Socratic pedagogy as students are encouraged to challenge traditional assumptions in terms of knowledge, opportunities, alternatives and augment their knowledge and understanding through participating in meaningful conversations with others. It involves collaborative and inquiry-based teaching and thinking which is the orientation of the Socratic pedagogy as students acquire an in-depth understanding of the subjects through self-construction of knowledge (Friesen & Scott, 2013). With the increasing emphasis on equipping tutors with the necessary pedagogic skills in the new B. Ed Curriculum so as to prepare them for effective delivery of the 4-year Bachelor of Education programme, there is good reason to explore the nature of different pedagogies in line with the Socratic ideals. To this end, Socratic pedagogy is a useful tool for imparting critical thinking and moral reasoning skills to learners. Socratic pedagogy is commonly used in Ghanaian classrooms ad question and answer approach.

For Boghossian (2004), Socratically-based programs have the potential to achieve the same objectives more efficiently, more cost-effectively, and in a more engaging way. Socratic pedagogy is primarily used to teach students how to think critically through a thoughtful examination of ideas and issues in any discipline. Socratic pedagogy is not limited to a specific arena of inquiry like law, teaching or philosophy. The Socratic Method is a good tool which is used to engage a large group of students in a discussion. It uses probing questions to get at the heart of the subject matter (Friesen & Stephens, 2016). The Socratic Method is not used to intimidate or to confuse new students but to develop in them critical thinking skills and to enable them approach teaching as professionals. This is in consonance with the expectations of the New

B.Ed. Curriculum which intends to develop in students both intellectual and professional skills.

Chin (2007) explained that as part of Socratic pedagogical underpinnings, when students learn science, they construct meanings and develop understandings in a social context and that, much of this meaning-making occurs through classroom discourse. It emphasises the interactions between the science tutor and preservice teachers across a number of classroom activities where the science teachers facilitate productive thinking in students using different questioning techniques as recommended for the new B.Ed. curriculum. As with many countries which have promoted curriculum reform, the New B.Ed. Curriculum for Colleges of Education in Ghana puts students at the centre of teaching and learning. It asserts that the students should experience a curriculum that engages and challenges them to be forward looking and inclusive as espoused by Socrates. In order to create a classroom environment where collaborative learning approach works, teachers must fully understand learners preferred learning styles and view of learning. To make this possible, it is recommended by T-TEL (2015) in the new B.Ed. Curriculum for tutors to use online - collaborative learning, jigsaw method, think- pair- share, integrated process approach and peer teaching.

2.3 Science Tutors' Knowledge about Pedagogies in B.Ed. Curriculum

Tutors' pedagogical knowledge is expected to encompass how students learn. It involves how students construct knowledge and acquire skills, and how students develop habits of mind and positive dispositions towards learning (Wang, & Liu, 2020). In this wise, the pedagogical knowledge of tutors is expected to cover an

understanding of cognitive, social and developmental theories of learning and how they apply to students in the classroom.

In addition, pedagogical knowledge also includes; a) classroom management, b) lesson plan development and implementation, c) students‘ evaluation, d) techniques or methods used in the classroom, e) the nature of the target audience, and f) strategies for evaluating students understanding (Hudson, 2013). In this case therefore, it can probably be concluded that a tutor who has knowledge of pedagogy and knowledge of content can effectively teach and help students achieve the desired learning outcomes.

Pedagogically powerful ways include; teaching strategies, lesson plan development and implementation, classroom management, and student assessment. Pedagogically grounded teacher therefore, knows what to do, when to do it, where to do it, and with whom to do it (Ssegantebuka, Sserunjogi, Edopu, Tebenkana, & Kanuge, 2021). Hudson (2013) asserts that this is critical knowledge pre-service teachers acquire while in teacher college and further develop it in schools as they practice teaching. However, pre-service teachers cannot develop what they do not have, the strong foundation of acquiring desired pedagogical knowledge starts in teacher training colleges with knowledgeable tutors. If tutors have desired pedagogical knowledge, then they can guide pre-service teachers‟ practices that later develops into the needed pedagogical knowledge for their school teaching.

Therefore, tutors‘ pedagogical knowledge is paramount when it comes to developing pre-service teachers‘ pedagogical practices in schools, where they go for employment. Based on the literature reviewed, pedagogical knowledge concentrates on classroom management; lesson plan development and implementation; students‘ evaluation; techniques or methods used in the classroom; the nature of the target audience, and

strategies for evaluating students understanding (Hudson, 2013). During teacher preparation, pre-service teachers are expected to acquire knowledge of planning to teach (for example: lesson plan, lesson objectives, lesson activities, presentation, teaching and learning materials and classroom management).

Knowledge of planning to teach, also makes reference to curriculum, syllabi and school timetables (Musingafi, Mhute, Zebron & Kaseke, 2015). Knowledgeable tutors are expected to possess the knowledge of planning to teach before they pass it to their pre-service teachers. It should be noted that these tutors can only pass on to the pre-service teachers the knowledge they have, where they have limited knowledge, they tend to omit it (Nbina, 2012). According to Tankersley (2010), tutors with knowledge of planning to teach can help their pre-service teachers learn how to prepare for teaching. For example, they guide pre-service teachers through structuring different lessons. They help them understand that different lessons and disciplines require different pedagogies. Different lessons can be structured to suit different learning environment, age level, and method of delivery that is affordable at that instant and space.

Tutors‘ possession of content knowledge is critical in teacher preparation. It can also be used to measure learners‘ achievement levels in teaching and learning situations (Ball, Thames, & Phelps, 2008). Tutors‘ knowledge and effective utilization of pedagogies in the new B Ed Curriculum is an area of concern and it cannot be underestimated in any effective teacher preparation. However, it is only tutors who are knowledgeable in pedagogies that can guide pre-service teachers through identifying and selecting appropriate pedagogies for a given lesson.

Ssegantebuka (2017) indicated that knowledgeable tutors are also in position to facilitate pre-service teacher‘s pedagogical knowledge search, acquisition and effective use in the classroom. The tutor‘s knowledge of the students, existing values and attitudes with rules and procedures, and understandings about specific students‘ needs and the wider socio-cultural contexts can be used to guide the pre-service teacher‘s development of classroom management. Knowledge of students is important in a number of ways, one of which is to guide the tutor in selecting the content, teaching strategies and other resources necessary in teaching.

Remarkably, the quantity of knowledge of students a tutor should have, is the same quantity of knowledge a pre-service teacher requires for effective teaching; therefore, a tutor must be in position to transfer suitable and appropriate pedagogies to the preservice teacher (Allday, Neilsen-Gatti, & Hudson, 2013). It is therefore, from this observation that the researcher argues that the tutors‘ possession of the knowledge and use of pedagogies in the new B Ed Curriculum is pertinent for two reasons; - it helps him/her to pass it on to the learner (the pre-service teacher) as well as employing the same knowledge to understand the pre-service teachers learning during their teacher training. In this circumstance, the tutor has to understand the linkages between development, knowledge and learning to support all aspects of a student‘s learning and development (Chong & Cheah, 2009).

Tutors need an understanding of preservice teachers‘ learning styles and preference of learning aids in selecting and sequencing experiences for quality learning, since knowledge of cognitive and emotional development influences the acquisition of skills in all aspects of education (Myftiu, 2015). Myftiu further intimated that, individuals differ in their preferred learning styles, and recognizing this is the first

stage in raising students‘ awareness of alternative approaches and helping them to be more flexible in meeting the varied demands of learning situations. Teachers also need to recognize their own individual learning styles as a basis for the development of effective teaching and learning strategies.

The teaching methods in science like any other practically oriented subjects include: project, group work, seminar, workshops, experiments, and demonstration among others (Aina & Langenhoven, 2015). Teaching in this 21st century requires that its practitioners clearly understand what should be done to bring about the most desirable learning outcomes in learners and be highly proficient in the skills necessary to carry out these tasks. These skills and understanding make up teaching methods which include a sounding knowledge of the strategies and techniques available, the ability to interpret the subject matter, familiarity with the nature of the learners and understanding of learning theory and its application (Kim, 2020). Tutors who have this kind of knowledge are likely to foster quality teaching in the Colleges of Education and engage pre-service teachers in quality learning.

However, the pedagogies tutors are currently using in their lesson delivery seem not match exactly what is prescribed in the new B Ed Curriculum. Some tutors still hide and use the former pedagogies in the classrooms (Harris & Hofer, 2011). One can argue that these are the pedagogies that the tutors were exposed to during their teacher training. Kharb, Samanta, Jindal, and Singh (2013) suggested that, for any teaching to be successful, the teaching method used should be tailored for the specific teaching-learning situation. In each one of these situations, teachers should strive for, what content to include, what procedures to use, how best to evaluate what the teacher has accomplished and how to reflect and repair any errors or omissions as well as clear

misconception in the students‘ learning. Pedagogical knowledge includes assessment of teaching and learning process among others. Assessment can be defined as the systematic collection, review and use of information about educational programs to improve student learning (Marsh, 2007). Mainly, assessment focuses on; what students know and are able to do, and what values they have when they graduate. Assessment is an ongoing process of setting high expectations for student learning. It measures progress toward established learning outcomes, provides a basis for reflection, discussion and gives feedback to improve school academic programs (Israel, Bauserman, & Block, 2005). However, in teacher education, assessment is mainly subjective rather than being objective, but tutors are expected to develop expertise in assessment as part of their professional preparation. Their understanding of assessment in developing effective use of appropriate pedagogies should be commensurate with their competencies in curriculum and instruction (Underwood, & Mensah, 2018).

Assessments in science can take many forms, including observation of student performance during instructional activities. Tutors should learn to use multiple methods of assessment, formal and informal, formative and summative, and a range of assessment strategies such as portfolios, journals, STS, Project work, laboratory experiments, presentations, class critiques and discussions. Using multiple methods of assessment in the colleges of education context is likely to improve teaching. Therefore, it was in the interest of the researcher to find out how tutors conduct assessment in the use of the pedagogies in the new B Ed Curriculum that brings effective learning.

2.4 Science Tutors use of Pedagogies in their Classroom Practices

Understanding the fundamental nature of science is embedded in inquiry-based learning, providing a better grasp of the concepts and processes of science. Inquiry in the elementary classroom combines a variety of skills and science processes. Students ask questions; make observations; plan and conduct experiments; gather and analyse data; use critical thinking; develop explanations, conclusions, and predictions; and communicate their findings to others (Lupton, 2012). The value of inquiry learning strategies has been noted in increased science achievement and cognitive development for students (Krajcik, Marx, Blumenfeld, Soloway, & Fishman, 2000).

A study comparing the effects of gender to inquiry-based teaching in the fourth grade found girls and boys both improved in science achievement when taught using inquiry (Coffie, 2020). This is especially interesting when considering the lack of student learning in science described by the Trends in International Math and Science Study (TIMSS). TIMSS reports that in the 2003 tests, United States fourth graders were outperformed in science by fourth grade students from 8 of the 24 participating countries. United States eighth grade science students were outperformed by 32 of the 45 participating countries. National Assessment of Educational Progress (NAEP) data establishes that American science students are not making progress towards catching up with science students in other countries, as NAEP science scores for fourth and eighth grade students show no improvement from 1996 to 2000 (US Department of Education, 2004). Critically, how well students gain a conceptual understanding of science is related to how their teachers teach science (Gabel, 2003).

To be effective, science teachers need to possess the ability to represent important ideas and abstract concepts in a way that makes them understandable to students. The

ability to make this connection is the root of effective teaching; effective teachers possess content knowledge and the pedagogy skills most effective to teach the subject matter (Koehler, Mishra, Kereluik & Shin, 2014) and in student learning. Scientific inquiry has a definite role in student success, but is there assurance that teachers are able to effectively implement inquiry learning pedagogy in their classroom? Research finds that inquiry-based instruction requires teacher skill beyond the usual pedagogy.

Teachers need to have an understanding of inquiry in order to effectively teach inquiry. Most teachers have not had opportunities to learn science in this manner or to conduct science inquiries themselves (Johnson, & Onwuegbuzie, 2004). The lack of skill and knowledge in science teaching is related to teachers‘ attitudes about science teaching (Senler, 2016). The word attitude describes outward and observable actions relating to beliefs. Attitudes are rooted in experience and affect what an individual will see, hear, think, and do. The outcome of attitudes is the tendency to react favourably or unfavourably to situations, persons, or events. Accordingly, teacher actions are shaped by their attitudes. Numerous studies agree on the positive correlation between science teaching attitudes and the ability to be an effective science teacher. Factors affecting teaching attitudes are found to include confidence about subject content, willingness to utilize curricular and pedagogical innovations, and a commitment to student learning (Kazempour & Sadler, 2015) explain that teachers who are comfortable teaching science are more likely to devote more time to science teaching and will teach with more creativity. Over the years, many studies have reported that teachers who have positive attitudes about their teaching can have a significant impact on their students‘ achievement (Koehler, Mishra, Kereluik & Shin, 2014; Zacharia, 2003; Erdogan, 2017). In contrast to previous research, however,

TIMSS found that teachers with positive attitudes about the NSES, in actual practice, do not follow reform standards.

Teachers rely on textbooks that cover a wide range of topics, emphasizing simple knowledge and routine procedures with little problem solving and critical thinking required of students. TIMSS concludes that teachers attempt to do what is expected of them but have insufficient time to teach the full range of content with the depth needed to meet the NSES. They select the quickest and easiest way to teach, which tends to be the pedagogy with which they are most familiar and use every day (Bocskor, Hunyadi, & Vince, 2017). There is a critical combination of qualities that enable teachers to succeed in standards-based teaching.

2.5 Factors that affect Science Tutors' use of Pedagogies in the implementation of New B. Ed. Curriculum

Contextual factors such tutors experience, school policies, professional development among others influence tutor's knowledge and use of pedagogies in the new B Ed Curriculum. Van Driel, Meirink, van Veen, and Zwart (2012) assert that, the knowledge and use of pedagogies take place within a context (school, department classroom and during teaching, learning and assessment) which affect the content, process and effects. Organisational factors have strong influence on the impact of the use of pedagogies as they determine whether a particular pedagogy will have impact or not. Organizational context is a key variable when it comes to the use of pedagogies since they can support or thwart the expected outcome of the use of pedagogies (Alebna, 2019). Harris, Mishra and Koehler (2009) stated that, the curriculum methods need to be facilitating to the academic needs and requirements of the students. Harris et. al. reported that the students enrolled in grade five are unable

to read the textbooks of grade three. Hence, this indicates that the teaching-learning methods and curriculum methods are not in a well-developed state. This is regarded as one of the major impediments within the course of enriching student learning. Hence, when the curriculum assistants are focusing upon development of pedagogical methods, they need to ensure, there are not occurrence of any blockades (Diem & Carpenter, 2012).

The impact of professional development activities also brings about change in the knowledge and use of pedagogies in the classroom practice of the teachers and this is in turn influenced by the context, teachers' previous knowledge and skills, the type of knowledge to be acquired and the network to which the teacher belongs to (Bocskor, Hunyadi, & Vince, 2017). According to Guskey (2002), a lot of factors account for the ineffectiveness of the use of pedagogies in the new B Ed Curriculum, key among them being the failure to take into consideration two crucial issues; the motivating factors for tutors to engage in the use of pedagogies in the new B Ed Curriculum and the process by which change in tutors occur. Other factors that affect the use of pedagogies in the new B Ed Curriculum include existing curriculum, standards, principals and colleagues, (Eberlein, Kampmeier, Minderhout, Moog, Platt, Varma-Nelson, & White, 2008; Supovitz &Turner, 2000).

The Teacher-Centered Systemic Reform model (TCSR) attach importance to context of teaching characteristics of teacher, thinking of teacher, and relation among them as powerful factors affecting the implementation of reforms in the classroom practices. Vescio, Ross, and Adams, (2008) argued that structural and cultural context in which the teacher finds him/herself affect his/her teaching practice. They identified structural context to include the characteristics of the school setting such as facilities

available, arrangement of furniture, subject area, schedules, textbooks, test, teaching and learning materials/resources and students. School contextual factors are important predictors of reforms in teaching. These school factors together with district and state policies are ‗powerful mediators' in influencing the impact of the use of the strategies or pedagogies in classroom teaching practice (Supovitz & Turner, 2000). Penuel et al., (2007), opined that effective use of pedagogies is affected by tutor's personal context such as science knowledge and frames of interpreting policies, school schedules, resources and time for planning and reflection; vision and leadership' and collective commitment.

Nehls, König, Kaiser and Blömeke, (2020) put it that teacher capacity interacts with system capacities to affect pedagogy use meant for reform. It is therefore significant that both resources needed for knowledge acquisition and likely barriers are considered for effective use of pedagogies in the new B Ed Curriculum in science education. They concluded their research by re-echoing the need to attend to factors that affect teachers' ability to change their teaching practice. There is therefore the need to attend to local barriers from school environment that teachers perceive to be barriers to gaining knowledge and use of pedagogies in their teaching practice. This is because even the highest quality professional development programs are limited in the likelihood of changing classroom practice when there are major disincentives for teachers to implement what they are learning.

Several empirical studies have looked at how the various contextual element affect professional development implementation (Stevenson, 2019; Supovitz & Turner, 2000). A study was conducted after two (2) national professional development programmes which were aimed at increasing teachers' knowledge about the principles

of active learning and scientific teaching (Barnett, & Hodson, 2001). The researchers used survey and video analysis of classroom teaching in the data collection process. A total of 221 participants were involved in the survey out of which 77 were selected for the video analysis. It was identified that the following were factors affecting teachers' implementation of professional development skills and of which directly affected the effective use of pedagogies:

(1) time constraints (time to plan, develop, or adapt materials; grade and give feedback; train colleagues or teaching assistants; and balance teaching with other activities),
(2) students (attitudes toward teaching methods and course evaluation feedback),
(3) implementation (classroom infrastructure and use of technology),
(4) support (through the campus administration, teaching rewards, tenure, financial, staff), and
(5) cooperation (of departmental and other faculty, teaching assistants, and staff.

A qualitative case study approach was use by Klein and Riordan (2009) to study eight teachers from New York City who participated in a professional development on the use of excursion in teaching. The researchers used interview and observation in the data collection process. After the analysis of the data, Klein and Riordan (2009) found that even though participants agreed that the principles and practices espoused in the professional development were good they thought it was not fit for their context, therefore some of the teachers rejected its implementation. Some of the teachers cited that students' skills and thinking level and school policy which were not appropriate for the implementation as their reasons for the rejection.

The researchers identified the following as factors influencing how teachers use pedagogies by way of implementing the professional development.

Engagement: The level of engagement and enthusiasm teachers have about professional development holistically had positive influence on their knowledge gain and how they use the pedagogies during teaching practice in the classroom. Klein and Riordan advised that the initial enthusiasm and energy that comes with professional development must be cleverly managed and sustained if teachers are to transfer it to their classrooms for students to benefit. Content area belief and knowledge: The researchers found that teachers‘ belief about the subject matter had direct impact on how they use pedagogies in their classroom teaching practice.

Assessment: It was found that assessment practices and policies also affected the way tutors use pedagogies in teaching practices. However, the results of this study cannot be generalized since it involved only ten science tutors. Penuel et al. (2007) conducted a study using 454 teachers who undertook a professional development aimed at preparing them to implement materials from an international earth science programme. The purpose of the study was to examine the effects of different characteristics of professional development on teachers' knowledge and their ability to implement the programme. Data for the study were drawn from teachers‘ survey, professional development providers‘ surveys and from programme database. Data were analysed using hierarchical linear modelling (HLM) framework. It was found that resources like equipment and technology had significant impact on the implementation, teacher knowledge and changes in science teachers‘ pedagogic practices.

Kannapel, Aagaard, Coe, and Reeves (2001) to determine impact of the Kentucky Education Reform Act, the researchers found that even though teachers were willing to practice the various elements of Standards-based pedagogies, many of them resorted to their traditional instructions. This was attributed to a lack of follow-up support after professional development, as well as teacher fears about how students would fare on state tests. Supovitz and Turner (2000) employed hierarchical linear modelling to study the relationship between professional development and reform pedagogic practice.

Using survey data from 3464 teachers and 666 principals in National Science Foundation Teacher Enhancement program called the Local Systemic Change (LSC) initiative, they identified the following as school factors that influence teachers use of pedagogies and other reform practices; supportiveness of the school principal, resource availability and socio-economic conditions. Supovitz and Turner, found that teachers who believed they had support from their principals reported significantly greater use of the pedagogies and other reform practices than those who did not believe they had the needed support from their school authorities. Schools' available resources, such instructional materials, time for teachers to plan and prepare lessons, and availability of science relevant supplies, also had a statistically significant influence on teachers‘ knowledge and the use of pedagogies in their teaching practices.

Socio-economic condition of the school, that is, poverty had great influence on teachers‘ practices as teachers from poorer schools seemed to use less of the reform‘s practices than their colleagues from schools whose students‘ population are well to do. The type of community in which the school is located also influenced teachers‘

reform practices. A relationship between tutors‘ knowledge and use of pedagogies outcomes and teachers‘ background characteristics such as teachers‘ experience and qualification must be taken into consideration when planning, implementing and evaluating tutors use of pedagogies in the new B Ed Curriculum. Teacher characteristics include prior experience, content knowledge, beliefs, and attitudes (Desimone, 2009). A study was conducted by Ebert-May et al. (2011) after two national professional development programmes: Faculty Institutes for Reforming Science Teaching (FIRST II) and the National Academies Summer Institute on Undergraduate Education in Biology (SI) at the University of Wisconsin which were all aimed at increasing knowledge about the principles of active learning and scientific teaching.

The researchers used survey and video analysis of classroom teaching. A total of 221 participants were involved in the survey out of which 77 were selected for the video analysis. From the analysis of the results of the survey, it found that the most significant and consistent predictor variable on the use of pedagogies and other reform practice after professional development was teaching experience, that is, the number of years of teaching. There was a negative correlation between years of teaching and implementation of reform teaching practice showing the new teachers implemented the reform-based teaching practice introduced in the professional development to a greater extent than the experienced teachers. A qualitative case study approach was use by Klein and Riordan (2009) to study eight teachers from New York City who participated in a professional development on the use of expedition in teaching. The researchers identified teaching experience as a factor affecting the use of pedagogies in teaching practice.

They noted that one big challenge in the use of pedagogies is how to –differentiate" pedagogies for teachers with different teaching experience. Desimone, Smith, and Ueno (2006) conducted a study using data from a survey, it was found that extent of teachers' content and pedagogical knowledge in mathematics had an impact on content and pedagogic-focused and sustained professional development participation. The researchers defined the extent of teachers' pedagogical and content knowledge to be the type of degree in mathematics and mathematics education. Using multinomial logit analysis, the researchers found that teachers who have their major or specialise in mathematics or mathematics education were more likely to participate in sustained content-focused professional development so that they acquire knowledge and use pedagogies than teachers who did not major in either mathematics or mathematics education. A study was designed to examine the relationship between features of a high-quality professional development and self-reported change in teachers' knowledge and effective use of pedagogies in classroom teaching practices (Garet et. al., 2001).

The study data was part of the national evaluation of Eisnehower Professional Development programme which provide financial support for the professional development of science and mathematics teachers. The researchers used data from Teacher Activity survey of 1027 teachers in 358 districts. After the analysis of data, it was found that teachers experience in teaching had significant positive relationship with changes in teachers use of pedagogies and other classroom practices after engaging in professional development. However, there was a negative correlation between teachers' experience and enhancement in their knowledge and skills. Supovitz and Turner (2000) conducted a study to examine the relationship between effective use of reform pedagogies and reform indicators.

The study found that teachers‘ years of experience had significant negative correlation with their investigative classroom culture while positively correlating with their use of inquiry-based teaching practices.

2.6 Conceptual Framework

Fig. 2 depicts the conceptual framework of the study. It is derived from the relevant literature particularly, the major themes reviewed. The major themes used in the literature such as science tutors‘ knowledge of pedagogies in the new B.Ed. Curriculum, science tutors‘ pedagogical practices, factors affecting tutors use of pedagogies and implementation of the 4-year B.Ed. Curriculum are discussed in the study. The relationship between science tutors‘ knowledge of the recommended pedagogies and their pedagogical practices is central to the implementation of the new B.Ed. Curriculum. Where the tutors‘ knowledge of the recommended pedagogies for science is deep, their ability and readiness to use such knowledge in their classrooms is greatly enhanced. It is also conceivable that the continuous use of the recommended pedagogies by the science tutors broadens their knowledge and expertise or professional competencies in the pedagogies.

Science tutors‘ knowledge of pedagogies in the new B.Ed. curriculum is considered central to the study because of the critical role that knowledge of pedagogies plays in teaching science in particular. Science tutors‘ knowledge of instructional strategies, introduction to cross-cutting issues, effective mechanisms for planning, behaviour management strategies, gender responsiveness, assessment to support differentiation and learning, implications of learners cultural, linguistic, socio-economic and educational backgrounds equip tutors adequately to meet the learning needs and progress of all student teachers.

Aside the knowledge of pedagogies in the new B.Ed. curriculum as discussed above, Science tutors' pedagogical practices are key to their success in implementing the college science programme. This is a professional practice which borders on three domains of managing the learning environment, teaching and learning and assessment. Managing the learning environment require tutors to plan and deliver varied and challenging lessons, showing a clear understanding of the intended learning outcomes of their teaching. It also involves carrying out small scale action research to improve practices as well as create a safe learning environment.

Managing the learning environment entails behaviour management of learners for both small and large classes. The domain of teaching and learning is where the tutor employs a variety of instructional strategies that encourages students' participation and critical thinking. Tutors are required to pay attention to all learners particularly vulnerable individuals such as girls and students with special educational needs. Tutors equally adopts instructional strategies that caters for the needs of all learners as regards mixed ability, multi-lingua and multi-age groupings. Tutors also sets meaningful tasks that encourages learner collaboration and leads to purposeful learning, explain concepts clearly using examples which are familiar to students and eventually produces and uses a variety of teaching and learning resources including ICT to enhance learning.

The assessment domain requires the teachers to integrate variety of assessment modes into teaching to support learning. The tutor listens to learners and gives constructive feedback. Tutors also identify and remediates learners' difficulties or misconceptions and refer learners whose needs are beyond their competencies for expert attention. Effective assessment entails the keeping of meaningful records on each learner and

communicates progress clearly to them. Tutors on this score are expected to demonstrate awareness of national and school learning outcomes of learners as well as use objective criterion referencing to assess learners.

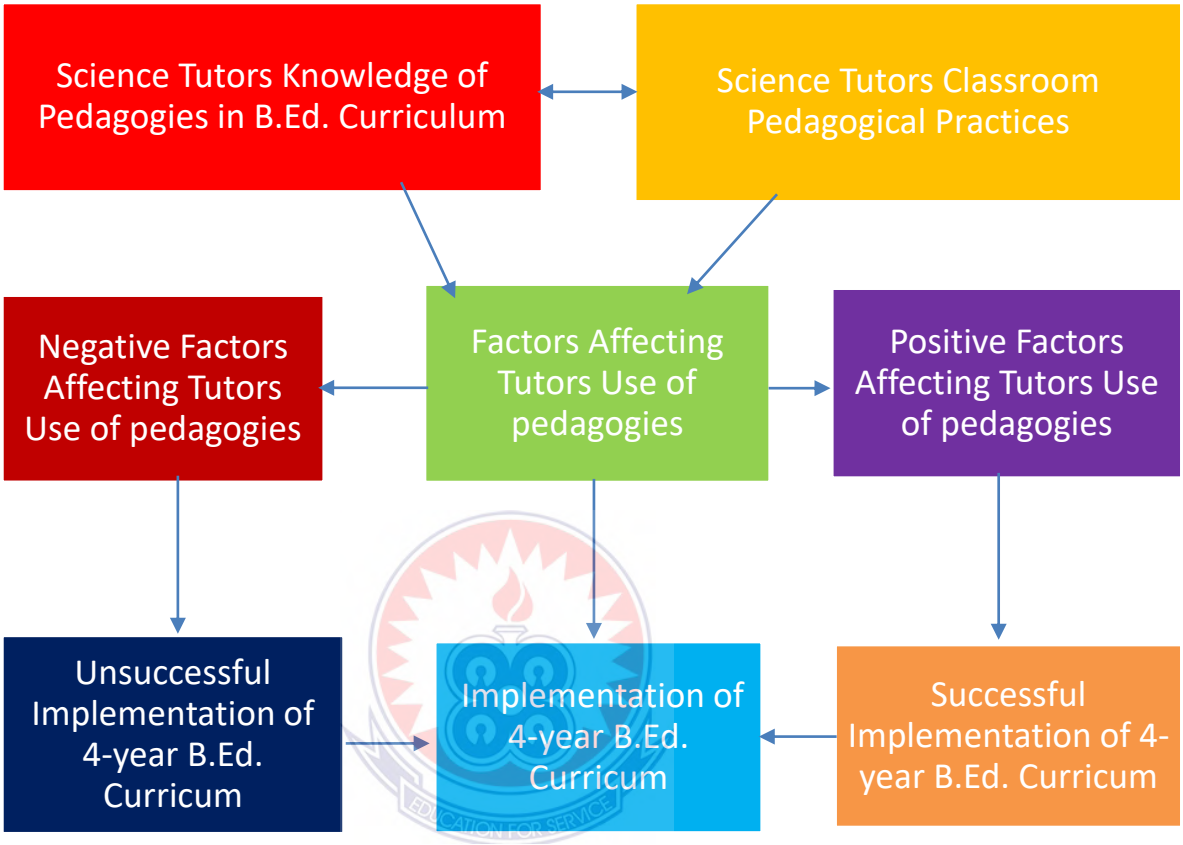

Fig.2: Conceptual Framework for the Study

There are several factors affecting tutors use of pedagogies in the new B.Ed. curriculum. These factors are the intervening variables between science tutors' knowledge of the recommended pedagogies, tutors' pedagogical practices and policy implementation. The intervening factors include tutors' experience, school policies, professional development and the tutors' self-efficacy. In this wise, the success or otherwise of the implementation of the 4-year B.Ed. Curriculum to a large extent depends on the pedagogical knowledge of tutors, their pedagogical practices and how well the intervening variables highlighted above are managed.

The acceptance or rejection of the B.Ed. Curriculum depends learners, resource materials and facilities, the teacher, the school environment, culture and ideology, instructional supervision and assessment. According to Chaudhary (2015), various factors that influence curriculum implementation and such factors are central to its acceptance or otherwise. These factors included but not limited to the teachers, the leaners, resource materials and facilities, the school environment, culture and ideology. In the context of this study, tutors in colleges of education view their role in curriculum implementation as an autonomous one.

Their position as in the classroom as professionals gives the opportunity to select and decide what to teach from the prescribed curriculum. Since implementation of the B.Ed. Curriculum takes place through the interaction of the student teacher and the planned learning opportunities, the role and influence of the tutor in the process is indisputable. If the tutor is to be able to translate the curriculum intentions into reality, it is imperative that the tutor possess the knowledge of the recommended pedagogies in the B.Ed. Curriculum well in order to implement it effectively. For tutors to accept the curriculum, then it expected that provision is made for them to play a more significant role in designing it. It is imperative that tutors are involved in curriculum planning and development so that they can implement and modify the curriculum for the benefit of their student teachers. Where the tutors‘ roles are recognised in curriculum development and implementation, they tend to accept and commit themselves to its success and the vice versa (Pobiner, 2016).

Student teachers are also a critical element in curriculum implementation. While tutors are the arbiters of the classroom practice, the student teachers hold the key to what is actually transmitted and adopted from the official curriculum. The official

curriculum can be quite different from the curriculum that is actually implemented. The student teacher factor influences tutors in their selection of learning experiences. Hence, the need to consider the diverse characteristics of the student teachers in the curriculum planning and implementation process is indispensable. Where these important factors are ignored, the acceptance of the curriculum by both tutors and student teachers becomes difficult to establish.

According to Likoko, Mutsotso and Nasongo (2013), no meaningful teaching and learning takes place without adequate resource materials. This is an important factor which determines the acceptance or rejection of a curriculum. For the officially designed curriculum to be fully implemented as planned, the college authorities should provide adequate resource materials such as textbooks, teaching aids and stationery in order to enable tutors and student teachers play their roles satisfactorily. The provision of physical facilities such as classrooms, laboratories, workshops, libraries and sports fields will light up the learning environment and make teaching and learning effective. The availability and quality of resource material as well as appropriate facilities will make the curriculum acceptable. The conclusion of Likoko et. al. (2013) is that where the provision of such critical resources is not in place resistance to the curriculum is bond to occur.

One other factor that influences curriculum acceptance or rejection has to do with the circumstances of each college. Some colleges are located in rich socio-economic environments and have adequate human and material resources. These colleges are more inclined to accepting a new curriculum than colleges without the requisite socio-economic resources to back the changes required by the new curriculum.

Cultural and ideological differences within a society or country can also influence curriculum acceptance or rejection. Some communities may resist a domineering culture or government ideology and that could trigger the rejection of a centrally planned curriculum which overlooks critical cultural values. For instance, Panchaud, Keogh, Stillman, Awusabo-Asare, Motta, Sidze and Monzón (2019) reported that the Comprehensive Sexuality Education (CSE) Policy Framework offers a supportive environment for school-based CSE and that in Ghana and Kenya sexuality education is not defined comprehensively enough as it focused largely on life skills and HIV without addressing topics such as contraceptive methods, sexual orientation and rights. Efforts by the government of Ghana in 2019 to project sexual orientation and rights in the Basic Schools curriculum was popularly rejected by Ghanaians and described the move as culturally alien.

2.7 Summary of Literature Review

The literature review explored both theoretical and empirical perspectives of the problem understudy. The theoretical framework used for justification for the need for tutors learning (acquiring pedagogical knowledge) and using the pedagogies learnt in their classroom teaching practices was B. F. Skinner‘s Reinforcement Theory. The views of this theory are that, a desired behaviour will be repeated if positive reinforcement (a pleasant consequence) tails the behaviour; and a behaviour will not be repeated if negative reinforcement (an unpleasant consequence) follows the behaviour.

This theory provided support for the need to provide tutors with pedagogical knowledge and they using it in teaching (positive reinforcement) that will increase students‘ academic achievements and effective delivery of the new B.Ed. curriculum.

It has emerged from the literature review that Government of Ghana (GoG) through the T-TEL programme offered tutors in the Colleges of Education the opportunity to learn and relearn through Continuous Professional Development.

This was to develop and improve tutors' knowledge and use of recommended pedagogies in the new B Ed curriculum to increase the learning outcomes of preservice teachers at the colleges of education. It was again realised that tutor's knowledge and use of pedagogies is influenced by factors such as:

i. **Content area belief and knowledge**: The researchers found that teachers' belief about the subject matter had direct impact on how they use pedagogies in their classroom teaching practice.

ii. **Assessment**: It was found that assessment practices and policies also affected the way tutors use pedagogies in teaching practices (Klein & Riordan, 2009), school context etc. It came to light from the review that many researchers found that pedagogical knowledge also includes; a) classroom management, b) lesson plan development and implementation, c) students' evaluation, d) techniques, strategies or methods used in the classroom, e) the nature of the target audience, and f) strategies for evaluating students understanding (Mensah, Bassaw, Bordoh, & Eshun, 2014; Hudson, 2007). It has been realized that effective use of pedagogies holds the keys to improving teaching and learning outcomes of science (Cakir, 2008) and are designed as part of reforms efforts with the aim to equip preservice teachers in colleges of education in Ghana with the requisite skills and competencies needed in the 21st century. In view of this, professional development programmes are designed to enhance tutors' knowledge and use of pedagogies in classroom practices (Armah, 2018).

It has emerged that the impact of the knowledge and use of pedagogies in the new B Ed Curriculum on tutors' instructional practices is affected by school contextual factors (such as leadership vision and support, policies and so on) and tutors' personal context such as their science knowledge. However, most studies on pedagogies neglect the impact of school context on the teacher's knowledge and use of pedagogies (Walker & Fraser, 2005). It also revealed that research on the use of pedagogies in the new B Ed Curriculum for science courses at higher institutions, specifically Colleges of Education were very rare as most studies on knowledge and use of pedagogies have concentrated on teachers at lower levels (Westbrook et al, 2013).

This study which looked at tutors' knowledge and use of pedagogies in the implementation of the new B.Ed. Curriculum in the teaching of Science at Colleges of Education in Ghana considered how contextual factors affect the knowledge and use of pedagogies in the science classroom. The study will address the information gap in literature on science tutors' use of pedagogies in their classrooms as recommended in the new B.Ed. Curriculum. The drive of this study is to provide useful information as to whether science tutors' have knowledge of the recommended pedagogies and how they use same in the classrooms for effective implementation of the 4-year B.Ed. Curriculum.

CHAPTER THREE

METHODOLOGY

3.0 Overview

In this chapter, the method used in carrying out the study has been discussed. The Sub-topics covered include: Research Design, Population, Sample, Sampling Technique, Data Collection Instrument, Data Collection Procedure and Data Analysis. The chapter ends with Ethical Issues.

3.1 Research Design

A research design according to Asenahabi (2019), is a plan and structure of the investigation used to obtain the evidence to answer the research question. Ivankova and Creswell (2009) also defines research designs as plans, strategies and procedures for research comprising decisions from the underlying worldviews to the detailed methods of data collection and analysis. The decision of using a specific research design is influenced by the assumptions of the researcher's personal experiences, audiences of the study, nature of the research problem, research strategy, and methods of data collection, analysis and interpretation. Case Study design was used for the study. This was to enable the researcher collect in-depth information on the problem understudy for analysis using both quantitative and qualitative data which case studies are suitable for. It was also the intention of the researcher to take advantage of the benefits associated with the use of Case Studies in relation to studies of this nature. A Case Study research design is a procedure that uses both quantitative and qualitative methods in a single study to gain in-depth information and to understand a particular issue. (Creswell, Klassen, Plano Clark & Smith 2011). Baxter and Jack (2008) noted that, case studies provide an opportunity to observe participants in an environment

entirely natural, thereby facilitating efforts to interpret phenomena in the way people understand them.

In this case, the school settings of the four Colleges of Education in the Northern Region where the tutors operate reflect this observation. It also provides in depth detail of the study, that is, it takes into consideration the attitude, `feelings and behaviour of the participants. Again, it brings about openness because the people can go further to give details of responses on what is being discussed. Finally, it simulates people's individual experiences. Golafshani (2003) however contended that, case studies tend to have higher internal validity but lower external validity. It has also been noted be time consuming to use because it requires the researcher to collect data by direct encounters through interviews and/or observations in addition to collecting quantitative data. With these in mind, the researcher used online questionnaires to collect the data quickly from the field. The researcher also focused on participant observation of tutors at two Science Colleges of Education in the Northern Region, E.P. College of Education, Bimbilla and Tamale College of Education to collect the information required.

3.2 Population

A research population can be explained as the participants or people that are being investigated in a scientific study (Draugalis & Plaza 2009). The target population comprised all science tutors in all Colleges of Education in the five regions in the northern part of Ghana. The accessible population for the study was science tutors in the Colleges of Education in the Northern Region of Ghana. The selection of this region was based largely on proximity, familiarity and accessibility to the researcher. The researcher, having taught in this region for years is familiar with the region of

study, and as such has easy access to the needed information for effective collection of data.

3.3 Sample and Sampling Procedure

The sample used for the study was drawn from two Colleges of Education in the Northern Region of Ghana. E P College of Education in Bimbilla and Tamale College of Education in Tamale constituted a subset of the accessible population. The sample used for the study was 25 and consisted of the entire number of science tutors from the two Colleges. This was made up of 14 and 11 science tutors drawn from E P College of Education and Tamale College of Education respectively.

The study employed convenient and purposive sampling techniques at various levels. The Northern Region was conveniently selected. This is because, the researcher teaches in the region and as such would have easy access to the needed information. There are four public Colleges of Education in Northern Region and purposive sampling was used to select two colleges within that region and the science tutors in these colleges constituted the study sample. The participants were those who teach science and had also taken part in most of the professional development sessions of the T-TEL. They were therefore in a better position to provide the right information about their knowledge and use of recommended pedagogies in the new B Ed Curriculum for Colleges of Education in their classroom teaching. The participants were constituted during a conference marking session organised by the Kwame Nkrumah University of Science and Technology at Kumasi in October, 2021. The telephone numbers of the science tutors were taken to facilitate communication between the researcher and participants. The telephone numbers were used by the researcher to share the link to the online survey on their WhatsApp platforms and use

phone calls for the interview when it was impossible to have face-to-face interview with the participants. Eight science tutors four from each college were purposively selected for the interview, and science tutors from E.P. College of education for lesson observations. The participants for the interview and tutors whose lessons were observed were conveniently selected. Convenient sampling was used because the researcher had easy access to those participants (subsample). Moreover, they were willing to take part in the interviews and had their lessons observed.

3.4 Data Collection Instruments

The instruments used to collect data were the questionnaire, observation schedule and interview guide for the reason of triangulation. Questionnaire was largely used in the data collection because many science tutors were reached for their opinion on the issue at stake.

3.4.1 Questionnaire

The questionnaire was designed by the researcher as an online instrument using google form. Link to the online questionnaire was shared on WhatsApp platform created by the researcher for the Bimbico and TACE science tutors' where they could access the link to complete the survey. The online questionnaire was used since it was convenient, cost effective, reliable and saved a lot of time. Again, most of the science tutors could be reached at the same time using the online questionnaire without the researcher travelling to the various tutors. Items of the questionnaire were set to cover both areas of tutors' knowledge about pedagogies in the B.Ed. curriculum and their use of recommended pedagogies in the new B.Ed. curriculum in their classrooms. Each area constituted a subscale making the instrument multidimensional. The questionnaire comprised three sections; A, B, and C which consisted of both open-

ended and closed-ended items (Appendix A). Section A covered tutors' demographic information: sex, age, years of teaching experience, qualification and workshops on B. Ed. programme attended.

Section B comprised 37 closed-ended items which focused on tutors' use of recommended pedagogies in the B.Ed. curriculum. It was a four-point Likert type scale which ranged from "not at all" to "a great extent". Each item consisted of a statement followed by four weighted options, not at all (= 1), to a small extent (= 2), to a moderate extent (= 3) and to a great extent (= 4). The participants were expected to indicate with a tick on options that best express their opinion about the statements. These items were set to elicit quantitative responses.

Section C was made up of 9 open-ended items which covered tutor's knowledge of the pedagogies in the new B Ed Curriculum and set to elicit qualitative responses. This implied that the questionnaire was used to collect both quantitative and qualitative data.

3.4.2 Observation Schedule

Observation is a systematic method to collect data (DiCicco-Bloom & Crabtree, 2006). Researchers use all the five senses to gather information on people in their natural locations. In this study, the researcher observed tutors in the classroom to identify the pedagogies in the new B Ed Curriculum they used in teaching and learning during science lessons. The purpose of the observation in this study was to ascertain and confirm tutors' responses to the questionnaire pertaining to their knowledge and use of recommended pedagogies in the new B Ed Curriculum they expected the student teachers to develop and use in their future lessons.

This gave the researcher first-hand information on the real situation on the ground in relation to the science tutors‘ knowledge and actual use of recommended pedagogies in the new B Ed Curriculum in their classroom teaching and learning in the college. The researcher developed an observation checklist which comprised 25 items. Out of the 25 items, six items dwelt on assessment, four items covered tutors‘ knowledge of pedagogies and 15 items focused on tutors‘ use of recommended pedagogies in the B.Ed. curriculum (Appendix B).

3.4.3 Interview

Interview was used after to probe issues on the observations further as it enabled the respondents to express their views in an unrestricted manner. A semi structured interview guide was prepared to further explore the issues raised by the sample‘s responses in the online survey and observation (Appendix C). The instrument was prepared by the researcher under the guidance of her supervisors. The items on the guide were 10 to cover the main research questions which guided the study. Out of the 10 items, three focused on research question one which covered tutor‘s knowledge about pedagogies in the B.Ed. curriculum. Four items covered research question two which was on tutors‘ use of recommended pedagogies in B.Ed. curriculum. Three items dwelt on research question three which explored factors that affect tutors use of recommended pedagogies in the B.Ed. curriculum. All the items were open-ended and were used as baseline questions for all participants to respond to. The items were set to obtain qualitative data. Interviews can provide effective explanations, clear illustrations and predictions for models about the working of systems but are prone to biases on the part of the interviewer. It is also burdensome to the researcher and the respondents and need complex analytical techniques (Desimone, 2009).

3.5 Validity of the Instruments

To ensure validity, the instruments were given to the researcher‘s supervisor, one Professional Development Coordinator and two science tutors to check whether the items were in line with the objectives of the study. They were also urged to check and to ensure that the items were unambiguous. The suggestions made by the reviewers were taken into consideration in finalizing the instruments.

3.6 Reliability of the Questionnaire

The questionnaire was converted into an online survey form using google. It was then pilot tested using four science tutors, two each from Gambaga College of Education and Bagabaga College of Education. The tutors‘ responses to the close ended items were used to establish the Cronbach‘s alpha reliability coefficient. The alpha value for the Section C of the instrument was found to be 0.837 (Appendix D). This reliability coefficient indicated that the instrument was reliable in line with prescriptions by Hurst, Mitchell, Kimbrel Kwapil, and Nelson-Gray (2007).

3.6.1 Trustworthiness of Interview Schedule and Questionnaire

The trustworthiness of the interview guide and the open-ended items in Section B of the online questionnaire were established. According to Caulfield, Xia, Veal and Maj (2011), Bryman and Cramer (2012), trustworthiness consists of four different components namely; credibility (the validity of the findings), transferability (the applicability of the findings in other contexts), dependability (reliability of the findings at another time), and confirmability (objectivity of the researcher while carrying out his/her research). All four combined constitute trustworthiness for any qualitative research.

The researcher ensured credibility by focusing on establishing a match between the constructed realities of respondents and those realities represented by the researcher through member check. Birt, Scott, Cavers, Campbell, and Walter (2016) explained that member checking consists of the researcher structuring, restating, summarizing, or paraphrasing the information received from a respondent to make sure that what is heard or written down is the correct response or member checking consists of reporting back preliminary findings to respondents or participants, seeking critical commentary on the findings, and potentially incorporating these critiques into the findings. To establish the credibility of this research findings, the researcher gave back the transcriptions of the interviews to the interviewees to check whether what were transcribed were true reflection of their responses. They were allowed to offer comments on whether or not they felt the data were interpreted in a manner consistent with their own experiences. The feedback from the participants increased the credibility of the findings of this study.

On the part of transferability, the researcher used thick descriptions include providing vivid explanations to substantiate and illustrate assertions made by individual participants to illuminate the contexts. The researcher further discussed thoroughly the research methods and procedures followed during and after data collection. Golafshani (2003) viewed dependability as the extent to which a study could be repeated by other researchers and the findings would be consistent. To establish dependability, it means that, the researcher requires an outside person to review and examine the research process and the data analysis in order to ensure that the findings are consistent and could be repeated.

Confirmability is the degree of neutrality in research findings. It involves making sure that researcher‘s bias does not skew the interpretation of what the research participants said to fit a certain narrative. This was taken care of in the study by the use of questionnaire, interview and observation to minimize instruments‘ bias. Moreover, the research methods were audited by a competent expert (researcher‘s supervisor).

3.6.2 Interrater member Reliability of the Observation Schedule

The reliability of the observation checklist was estimated using the interrater. It focuses on the consistency of measure across raters or the degree of agreement between different observers‘ observation. In this study, 3 tutors from Gambaga College of Education were made to test instrument. Based on an assessment criterion for the observation checklist, the 3 tutors submitted closely same results for the same lesson observation. This indicates that the observation checklist has high inter-rater reliability. The checklist was therefore maintained with modification of two items.

3.7 Data Collection Procedure

Collecting data for the study was done in three phases. The first phase involved administration of the online questionnaire. This online survey was done using google form. The link was for one month, (between 7th January to 6th February 2021), for tutors to complete the survey. Consent form was attached to the survey in which tutors required to tick to indicate their willingness to participate in the study. Google automatically collected the responses as soon as it was completed and sent. The link to the survey was shared on the WhatsApp platform created by the researcher for both E. P. College of Education and Tamale College of Education Science Tutors. The link was for one month, such that respondents could complete the survey. Consent forms

were also attached to the survey to solicit the acceptance of the respondents to participate in the study. They were asked to indicate their willingness to participate in the study. All the study participants completed to give a 100% completion rate. Google automatically collated the responses immediately the participants completed the questionnaire. The collated responses were then sent to the researcher‘s email.

The second stage involved conduction of interviews with the sub-simple after seeking their consent. Moreover, the researcher probed issues that need more clarity. There were some instances where follow up questions which were not part of the baseline questions were asked depending on interviewee responses. The interviews were either through face-to-face discourse or through phone dates and time agreed upon. The interviews were audio recorded with the consent of the interviewees. The average time for the interviews was 45 minutes. The whole data collection process took place within one month.

The 3rd stage involved observation schedule. The observation was carried out after the interview. This was meant to confirm tutors‘ responses to both the questionnaire and interview. In observation, data was collected on the tutors‘ use of pedagogies in the new B. Ed. Curriculum by watching them (tutors) and ticking, listing and recording what was observed rather than asking questions about them. The researcher observed lessons of science tutors to ascertain their real classroom practices and validate their claim of having good knowledge and using the recommended pedagogies in the new B Ed curriculum and other classroom practices such as sitting arrangement, creating learner friendly environment, class control and management etc. in the questionnaire and interview responses.

This helped the researcher to obtain first-hand information on tutors‘ knowledge and actual usage of pedagogies in the new B. Ed. Curriculum for Colleges of Education in Ghana. The observation was done on two occasions, and this took place between February and March, 2022. An observation checklist consisting of 25 items was used by the researcher. During each visit, the researcher required to put a tick in the appropriate column (Yes = strategy used) and (No = strategy not used) on the observation made during the lesson on the checklist. Notes were also taken on practices that were not captured by the checklist. As a non-participant observer, the researcher tried to be objective and not get involved in the dynamics of the class.

3.8 Data Analysis

This study obtained data using qualitative and quantitative methods, therefore, data was analysed both quantitatively and qualitatively.

3.8.1 Quantitative data analysis

Quantitative data was obtained from Section C of the questionnaire and observation checklist. SPSS software was used to compute the mean, standard deviation and percentages. The descriptive statistics functions of the software were used to organize the responses into frequency charts and converted into percentages. The data from the lesson observation were organized into frequency charts and converted into percentages. These were also presented in frequency tables and charts. The mean score and standard deviation were also determined. Research question two were answered using data from the questionnaire (closed-ended items) and the observation checklist.

3.8.2 Qualitative Data Analysis

Research questions one and three were answered using qualitative data from interview and the open-ended items in Section B of the questionnaire.

The data was analysed using typological analysis (Senz, Hacht, Bukoski, Kim, Lee & Veldez, 2011). Typological analysis begins by dividing the overall data set into categories based on predetermined typologies. Tutors' responses to the open-ended items in Section B of the questionnaire were automatically collated and save by Google. This data was retrieved and regrouped into related themes with little changes made to it and presented in paragraphs.

Similarly, the audio-recorded interview was transcribed verbatim. The interview data was also typologically analysed. Initial typologies were generated by the researcher based on research questions to be answered. The transcribed data was read by the researcher and information related to the typologies were marked. Also, entries were read and recordings of the main ideas in the entries were determined and recorded on summary sheets for each of the interviewees. The summaries were evaluated and patterns identifies and developed into themes.

3.9 Ethical considerations

Ethical issues were considered by the researcher as it is related to the way educational researchers conduct themselves or their practices and the consequences of these on the research participate. Ethical issues that were considered in this study are the permission to collect data, informed consent, confidentiality, and anonymity. A research authorization letter was obtained from the University of Education, Winneba. Permission to interview participants was sought from Principal and an information sheet seeking participants' permission to be part of the study was given to all participants. Consent form was also attached to the survey (online questionnaire) in which participants ticked to indicate their willingness to participate in the study. Confidentiality of participants and the information provided was guaranteed.

The researcher made sure that information provided by participants was treated with care so that it does not get to unauthorized persons who are not connected to the study in any way. The data collected from participants were also used for the purpose of the study only. The researcher did not ask embarrassing questions or make statements that would lower the self-esteem of respondents. Anonymity of participants were also guaranteed. Anonymity means that the researcher cannot identify the participants from information that has been gathered. This implies that there is no way for the researcher(s) to know who said or did what, even when inspecting data that are collected (Ngozwana 2018). The researcher ensured that participants did not provide their names and addresses on the questionnaire.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presented results obtained after administering questionnaire, conducting interview and making lesson observations. Data from the use of the instruments yielded both quantitative and qualitative data and were analysed both quantitatively and qualitatively. The online survey (closed-ended items) and observation checklist which yielded quantitative data was analysed using descriptive statistics. The results of the analysis were presented as frequency tables, pie and bar charts. The data from interview and open-ended items of the questionnaire data was analysed thematically in line with the research questions. The results were presented based on the research questions. The findings of the study were also discussed in this chapter. The chapter is organized in three parts. The first part examines the demographic composition of the sample which was obtained from the questionnaire. The data presentation with respect to the research questions is done in the second part, and finally, the discussion of the results is captured in the third part.

4.1 Sample Characteristics

Section A of the questionnaire comprised items 1 to 5 required participants to provide their demographic characteristics such as gender, teaching experience at the college, highest educational qualification, number of workshops and professional development sessions attended.

4.1.1 Gender distribution of sample

From Fig. 3, 25 science tutors responded to the online survey of which 22 (88%) were males and 3 (12%) were females. This indicated that majority of the science tutors at the Colleges of Education in the Northern Region were males. This implies that the teaching of science at the Colleges of Education (CoEs) especially in the Northern Region is dominated by males. This again suggests a wide gender disparity in favour of the male tutors. This situation calls for a deliberate recruitment drive of female science tutors into colleges of education in Northern Region to close the gender gap and to make recruitment of science tutors' gender responsive in the colleges of education. More female science tutors teaching in the CoEs can serve as role models for female pre-service Science teachers.

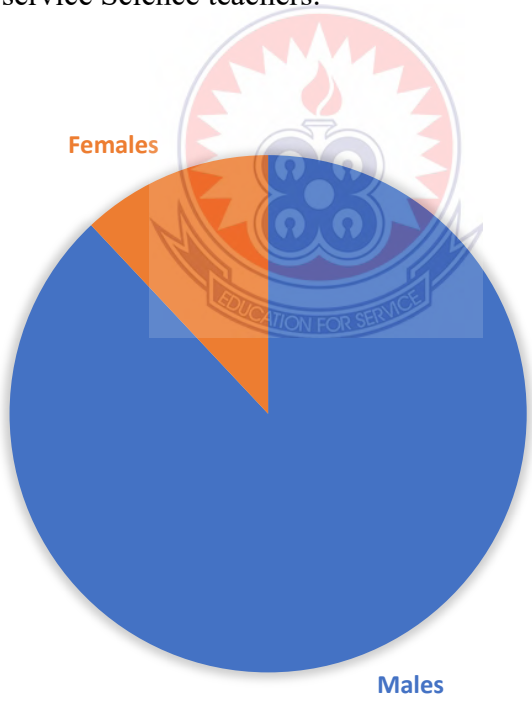

Fig. 3: Gender Distribution of Sample

4.1.2 Years of Teaching in the College

The teaching experience of the respondents is given in Table 1.

Table 1: Teaching Experience of Respondents

Number of years of Teaching	Frequency	Percentage
1- 5 years	6	24
6- 10years	6	24
11- 15years	13	52
Total	**25**	**100**

Table 1 indicates that science tutors had varied years of teaching experiences with most of them (n=13, 52%) having been teaching between 11 to 15 years in the Colleges of Education. Majority of the tutors (52%) had between 11-15 years of teaching experience at the college while six tutors (24%) of the sample had between 1-5 years of teaching experience at the college and same for the range of 6-10 years. The results indicated that a larger number of the science tutors had more years of teaching science at college level. Some of the tutors who had gained a lot of teaching experience (11-15 years) may have had problems adjusting to the demands of the new curriculum as result of being used to their old ways of teaching. The new B.Ed. curriculum is a reform which comes with new ideas in areas such as content, pedagogies and skills. In the light of this, tutors who were already teaching in the colleges before the introduction of the B.Ed. programme (pre-B.Ed. Tutors) would have to adjust to meet the demands and requirement of the new curriculum. Since it is not always easy for a change to occur, this adjustment of the pre-B.Ed. tutors may seem challenging to them and they may therefore have challenges with the use of the new pedagogies and implementation of the B.Ed. curriculum. However, tutors in the

range of 1-5 who joined the colleges at the start or just after the introduction of the new B.Ed. curriculum (post-B.Ed. tutors) probably would have less challenges in using the recommended pedagogies because their previous teaching experiences were shaped during the professional development training as new tutors.

4.1.3 Highest Educational Qualification of Respondents

The highest educational qualifications of respondents are shown in Table 2.

Table 2: Highest qualification of Respondents

Qualification	Frequency	Percentage
PhD	0	0
MPhil	9	36
MSc	3	12
M.Ed. (Science)	13	52
Total	**25**	**100**

As seen in Table 2, majority of the tutors (52%) had their highest qualification to be Masters in Education (MEd) while 9 (36%) of the tutors had MPhil degree and 3 (12%) of tutors had MSc. The implication is that there is the urgent need for science tutors to upgrade and acquire M.Phil. and/or Ph.D. degrees in Science Education to increase their self-efficacy in the use of recommended pedagogies for teaching science in the new 4-year B.Ed. curriculum.

4.1.4 Number of workshops on the B.Ed. programme attended

The number of workshops on the B.Ed. programme attended by respondents are presented in Table 3.

Table 3: Number of workshops on B Ed Programme attended by respondents

Number of workshops attended	Frequency	Percentage
1-5	17	68
6-10	7	28
11-20	1	4
Total	**25**	**100**

Majority (17, 68%) of the tutors indicated that they attended workshops on the B.Ed. programme ranging from one to five times. From Table 3, one tutor representing 4% indicated the highest attendance of the workshops between eleven and 20 workshops. This person probably is a PDC who attends many workshops on the B.Ed. Programme and possibly had many years of teaching experience. The remaining 7(28%) stated that they attended the workshops ranging from six to ten times.

4.1.5 Number of PD Sessions attended by the Respondents

The data displayed on Table 4 show the number of PD sessions tutors attended within two years.

Table 4: Number of PD Sessions Attended by Respondents

Number of PD Sessions attended	Frequency	Percentage
10-19	8	32
20-29	9	36
30-39	7	28
40 and above	1	4
Total	**25**	**100**

From Table 4, eight (32%) science tutors indicated they attended 10 to 19 PD sessions. Also 9 science tutors (36%) stated that they attended 20 to 29 PD sessions.

The data further indicated that 7 (28%) science tutors admitted that they attended 30 to 39 PD sessions whiles one science tutor representing 4% attended 40 and above PD sessions. This tutor possibly was one of the PDCs with longer years of teaching experience at the College of Education. The data indicated that majority (68%, 17) of the science tutors who participated in this study attended between 10 to 29 PD sessions.

4.2 Research Question One: What is the level of science tutors' knowledge about the recommended pedagogies in the new B.Ed. Curriculum?

Research Question one sought to examine science tutors' level of knowledge about pedagogies in the new B. Ed curriculum. There were nine open-ended items in Section C of the questionnaire (Appendix A) that sought to assess the tutors' knowledge of pedagogies in the new B. Ed curriculum. The open-ended items in the Section C of the questionnaire yielded qualitative data. Respondents were required to respond by providing short answers to the items. For analysis's sake, the responses were summarised, regrouped thematically and presented in paragraphs. The data for the research question one was presented based on the indicated items.

4.2.1 Summary of participants responses to open-ended questions

Item 1: How do you feel about your old (previous knowledge) in the recommended pedagogies in the new B Ed curriculum?

Item one of Section C (online questionnaire) sought information about science tutors' knowledge about pedagogies in the B.Ed. curriculum. this was to determine whether science tutors already had related knowledge about recommended pedagogies in the new B.Ed. curriculum. The item elicited responses on tutor's previous knowledge in pedagogies in the new B.Ed. curriculum. Tutors were required to provide short

response to the item on how they feel about their previous knowledge (old curriculum) and the pedagogies in the new B.Ed. curriculum. The tutors' responses on the items were summarised and regrouped into themes.

In their responses, majority of the tutors stated that their previous knowledge in the old curriculum (that is, Diploma in Basic Education curriculum and others) was in line with their knowledge about recommended pedagogies. Tutor's response to item 1 further indicated that they feel good about their previous knowledge in the recommended pedagogies in the new B Ed curriculum. Among the responses of the tutors were; "I feel good, am adequately prepared to use pedagogies in my teaching and the recommended pedagogies is in line with my previous". This implies that tutors were comfortable and had sound previous knowledge about pedagogies in the new B Ed curriculum.

Item 2: How do you create a positive learning environment?

Item 2 of the Section C sought to explore how science tutors create positive learning environment in their classroom. This was to assess science tutor's knowledge of the instructional strategies embedded in the recommended pedagogies. In response to how tutors create a positive learning environment, tutors asserted that positive learning environment can be created by way of Using adequate TLRs and multiple strategies alongside motivation. Tutors also indicated working in groups and through interaction as ways by which they create positive learning environment. Some tutors however opined that ensuring effective classroom management and using inclusive strategies can equally create positive learning environment. Other tutors maintained that encouraging students to respect other students' view as well as encouraging learners to contribute to learning by reviewing and linking their RPK to the present

lesson creates positive learning environment. On the whole, tutors‘ responses to item 2 showed that they use varied strategies to create positive learning environment. Generally, tutor‘s knowledge about how they can create a positive learning environment could be described as average.

Item 3: How would you rate your knowledge level about pedagogies in the new B.Ed. curriculum for Colleges of Education in Ghana?

In item 3, tutors were asked to rate their knowledge level about pedagogies in the new B.Ed. curriculum for Colleges of Education in Ghana. This was to give tutors the opportunity to rate themselves as far as knowledge of the pedagogies in the B.Ed. curriculum was concerned. Among the 25 respondents, 4 (16%) of the tutors rated themselves as –excellent", 12 (48%) tutors gave a rating of –very good" and 9 (36%) rated themselves as –good". This means that majority of the tutors see themselves as having very good knowledge level about pedagogies in the new B Ed curriculum as can be seen from their responses that, a total of 21 tutors representing more than half of the sample rated themselves as –excellent" and –very good".

Item 4: During lessons, what types of pedagogies do you like to encourage?

Item 4 of the questionnaire (Section C) sought information about the type of strategies or pedagogies that the science tutors like to encourage in their lessons. The responses of the tutors to item 4 purposed to examine what types of interactions they like to encourage showed that they liked to encourage discussions in either small group or whole class, to encourage Groupings/ groupworks and positive interaction. Other tutors maintained that they liked to use question and answer type interaction between learners and tutor. Similarly, tutors indicated that they liked to create student-tutor

rapport, and student to student interaction, e-learning opportunity. The science tutors also pointed that they liked to use think pair share type of interaction to create positive learning environment.

Item 5: What is your understanding of the features of Supported Teaching in School (STS)?

The item 5 sought to obtain responses on tutors' understanding of the features of Supported Teaching in School (STS). Responses from tutors showed that their understanding of the features of STS is to train student teachers to become competent in their profession and that it allows learners the opportunity to correct their misconception about teaching before they complete their training. These responses therefore imply that tutors had the understanding of the features of STS.

Item 6: In conclusion, suggest two (2) ways by which tutors knowledge of pedagogies in the new B Ed curriculum can be effective especially in teaching and learning?

When the tutors were asked to suggest ways by which tutors knowledge of pedagogies in the new B Ed curriculum can be effective especially in teaching and learning, they indicated constant application of the pedagogies and provision of TLRs. In addition, tutors added that application and ways of delivery are ways by which their knowledge of pedagogies can be effective. The tutors also opined that the knowledge of pedagogies can be effective by applying what they learn and also be innovative in their teaching. Similarly, tutors posited adherence to the prescribed pedagogies and interactive approaches as ways by which knowledge of pedagogies can be effective. Science tutors were also of the assertion that tutors make use of pedagogies in all lessons and encourage learners to do same. A closer look at the

responses indicated that tutors shared similar views as it can be seen that, all the responses in one way or the other boarded on application or use of the pedagogies.

Item 7: After a lab experiment that involved magnetism, a preservice teacher writes that all metals are attracted to a magnet. Identify this preservice teacher‘s misconception and describe an appropriate strategy to counteract this misconception.

The tutors were further probed to suggest an appropriate strategy to counteract the misconception for the scenario in item 7. It was found that 5 of the tutors each suggested concept mapping and practical experiment to show to the preservice teacher as the appropriate strategy to correct the misconception while 10 tutors constituting the majority pointed demonstrations, practical or inquiry-based approach as the appropriate strategies to correct the misconception. Responses of Tutors to item 8 were collected. The item 8 is a scenario which is read as; A tutor started a lesson by saying that ~~–in~~ our red blood cells, a protein called haemoglobin reacts with oxygen.” Preservice teachers were not clear about the lesson after this daily life example. In your opinion, kindly indicate the instructional strategies to be employed by the tutor to facilitate easier understanding of the concept. Tutors‘ responses to the item 8 are shown in Fig. 4.

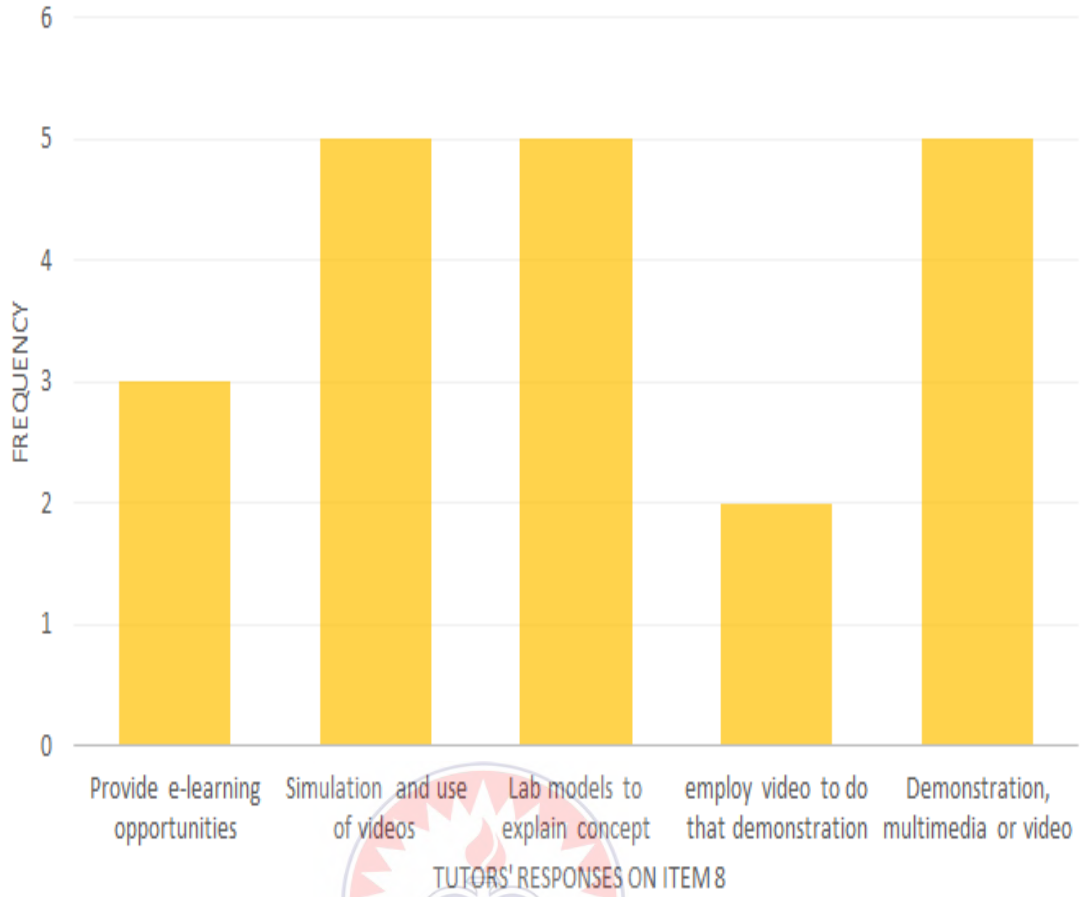

Fig. 4: Responses of Tutors on Item 8

From Fig. 4, it can be seen that, 3 tutors‘ responses were on providing e-learning opportunities for preservice teachers, 5 tutors opined that simulation and use of videos can be employed to facilitate easy understanding of the concept. Another group of 5 tutors also shared the view that using of Lab models to explain concept can be used to facilitate easier understanding of the concept. From figure 4, two other tutors showed that the use of video to carry out demonstration for the students to enhance easier understanding while the rest of the 5 tutors reiterated that demonstration, multimedia or video can be used to facilitate easier understanding of the concept.

Item 9: Tutor takes her Early Grade science preservice teachers to the laboratory for a ―hands-on" experience with change of states of matter. A fizzy-drink can was taken out of the fridge, and after a few seconds, the can started to ―sweat". The tutor asks

preservice teachers to describe the mechanism leading to the sweating of the can. Suggest suitable pedagogies that can be used in this scenario;

Item 9 as well, sought to obtain tutors‘ suggestions about suitable pedagogies and assessment modes that can be used in the scenario. The response obtained is shown in Figure 5.

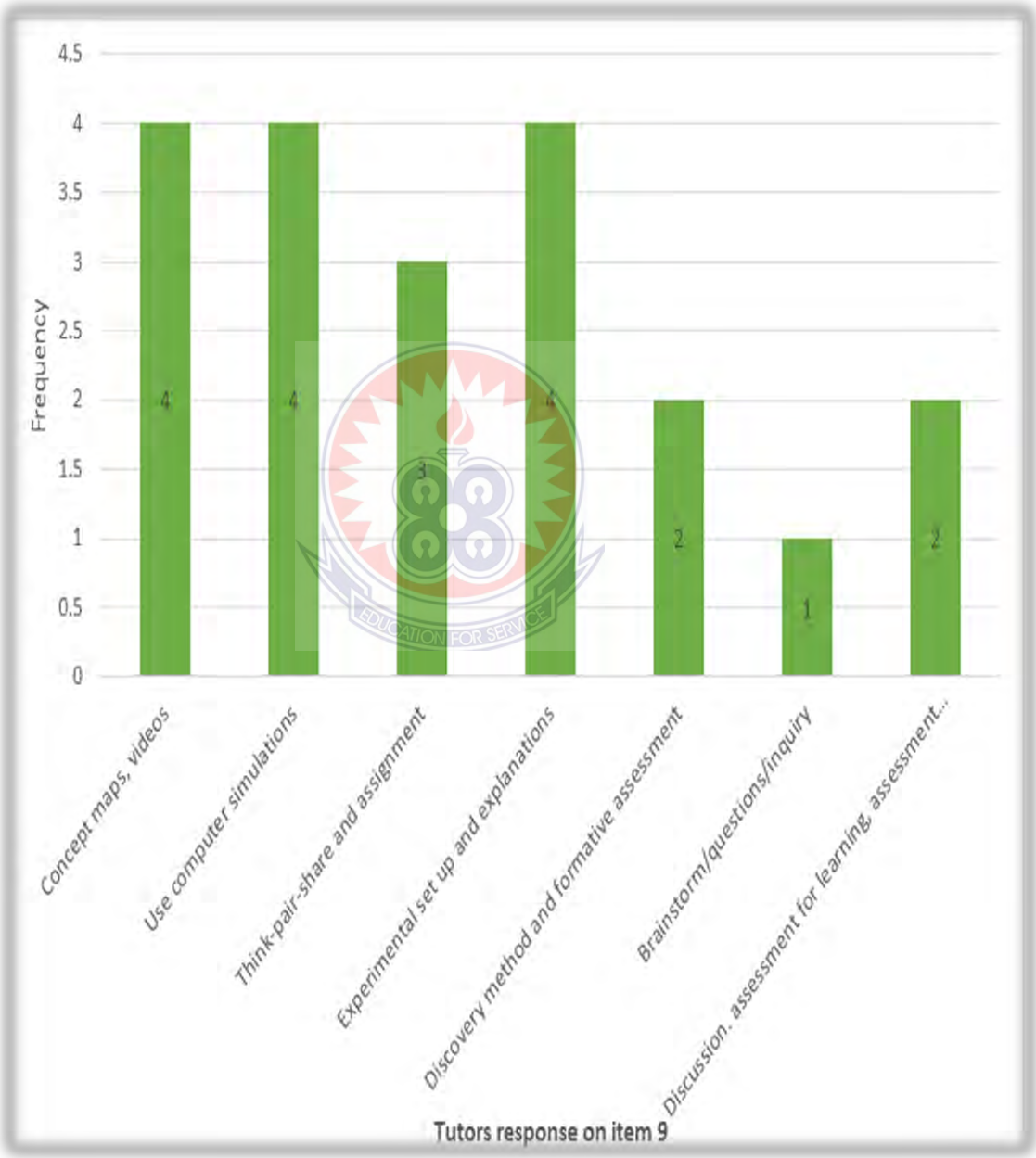

Fig. 5: Responses of Tutors for Item 9

In line with the responses shown in figure 5, 4 tutors suggested concept maps and videos, another 4 tutors suggested computer simulations, 3 tutors suggested think-pair-share and assignment. Other 4 tutors gave their suggestion as experimental setup and explanation while the rest of the tutors gave responses such as discovery method and formative assessment (2), brainstorm, questions, inquiry (1) and discussion, assessment for learning, assessment as learning (2). The tutors indicated that all these suggested strategies shown in Fig. 3 were suitable strategies or pedagogies and assessment modes that can be used in the scenario.

4.3 Research Question Two: To what extent do science tutors use the recommended pedagogies in the New B.Ed. Curriculum in their teaching practices?

Research question two sought to assess science tutors use of pedagogies in the new B. Ed Curriculum for science teaching. Both qualitative and quantitative data in line with this research question is discussed. The responses to the items (Section B) on the online questionnaire were in a four-point Likert format of 0 (to a low extent), 1(to a small extent) 2 (to a moderate extent) and 3 (to a greater extent). The items were grouped under the various types of pedagogies. A standard mean of 1.5 of which constituted the average of the scores was used for interpretation of the mean values. Mean values below 1.5 were considered as low extent of tutors‘ use of recommended pedagogies in the new B Ed curriculum while mean values above 1.5 were considered as greater extent of tutors‘ use of recommended pedagogies in teaching of science. The responses of tutors on their use of recommend pedagogies in the new B.Ed. curriculum are presented in Table 5.

Table 5: Means, Standard Deviation and Percentage Scores for items on Tutors' use of Recommended Strategies and Pedagogies in the new B.Ed. Curriculum in Science Teaching

Item	%Responses	Mean	Standard deviation
Constructive pedagogy			
Discuss course manual with preservice teachers	15.0	2.25	.79
Use of starter/ energizer to begin lessons	90.0	2.10	.79
Use of science related Games	77.5	2.10	.91
Use of Storytelling	92.5	1.75	.79
Use of Songs and rhymes	87.5	1.45	1.00
Use of Roleplay	75.0	1.95	.83
Use of Modelling	57.5	2.30	.73
Use of low/no cost TLRs	55.0	2.32	.72
Use of gender responsive strategies	47.5	2.25	.66
Use of appropriate sitting arrangement	30.0	2.31	.73
Create learner friendly environment	12.5	2.03	.79
Mean Score		**2.07**	**0.81**
Integrative Pedagogy			
Identify the standards your lesson will address	22.5	2.32	.76
Practising inclusivity	27.5	2.05	1.10
Align performance indicators, teaching and assessment		1.61	.88
Identify possible misconceptions of your lesson that		1.85	.71
pre-service teachers may bring to class	20.0	1.85	.71
Use of motivational techniques	60.0	1.95	.89
Managing the learning environment	25.0	2.40	.68
Use of concept maps and cartoons	40.0	1.95	.89
Mean Score		**1.99**	**0.83**
Inquiry-based Pedagogy			
Use of fieldtrips to identify important scientific scenes	45.0	1.50	1.00
Use of pyramid discussions	70.0	2.00	.86
Use of multimedia	62.5	1.90	.91
Use of videos	97.5	2.00	.86
Use of simulations	85.0	1.50	.83
Guide preservice teachers to develop portfolio	67.5	1.55	.83
Use of e-learning opportunities	42.5	2.00	.79
Use of inquiry learning	52.5	1.75	.97
Mean Score		**1.77**	**0.88**

Collaborative Pedagogy			
Use of groupwork	50,0	2.14	.73
Use of seminars	82.5	2.05	.76
Use of think, pair, share teaching and learning strategies	95.0	1.95	.76
Use of PowerPoint presentations	65.0	2.10	1.07
Use talk for learning approaches	100	1.80	.70
Use of computer presentations	37.5	1.90	.64
Mean Score		**1.82**	**0.78**
Reflective Pedagogy			
Use of reflective practices	72.5	2.20	.83
Assessing students based on the National Teachers Standard	25.0	1.80	.89
Use of self and peer strategy to assess preservice teachers	80.0	1.90	.85
Use of models‘ presentation by preservice teachers for assessment	32.5	2.35	.59
Use of assignments to assess preservice teachers	35.0	2.00	.73
Mean Score		**2.05**	**0.79**
Overall Mean Score		**1.9**	**0.82**

It can be seen from Table 6 that items on tutors‘ use of constructive pedagogy which included items like, use of games, use of story-telling, use of role play, use of modelling, use of groupwork and use of varied assessment strategies such as use of models‘ presentation by preservice teachers, assignment, self and peer strategies etc, were all rated above the standard mean of 1.5 with the exception of the use of songs. From Table 5, all items on Integrative Pedagogy which covered the range of items from identifying which standards will be address by your lesson” to ―use of concept maps and cartoons” had rating higher than the standard mean of 1.5 indicating that those pedagogies (rating higher than the standard mean of 1.5) were used to a high extent by the tutors. As it can be seen from Table 5, the strategy that realised the highest use under the Integrative Pedagogy was managing learning environment (M=2.4, SD= .68).

Similarly, items ranging from ―Use of PowerPoint presentations” to ―Use of simulation” focused on Inquiry-based Pedagogy. Use of models‘ presentation by

preservice teachers for assessment was used to a high extent (Mean=2.35, SD=.59). This can be verified in the comments made by a tutor during the interview. The tutor stated as follows: ―Managing learning environment well gives all students equal opportunity to participate in the lesson and make them feel belonging in the class".

At the heart of the new B. Ed curriculum and hence the recommended pedagogies are the issues of gender and inclusivity. From Table 5, it is shown that the items on these issues were rated by the tutors as being used greatly in their teaching. The item ―Use of gender responsive pedagogy" as shown from Table 5 recorded a mean score of 2.25 (SD^2 = .65) while the ―practising of inclusivity" had a mean of 2.05 ($SD^2$1.05). The great extent to which these strategies were used can be attested to in the comments made by tutors during the interview as;

> *In the elective science class at one hand, you see few females who are there…so if you try to bring the female students on board using the techniques that T-TEL (professional development ideas) has taught us, the female students are now willing to answer questions and participate in class activities during science lesson than they used to do before. you see the female students coil somewhere because they think that science is only for males. But then, you go to use nice way (gender responsive pedagogy) to get them on board… Then on the other hand, you see few male students in Early Grade and Primary Education classes who are there… and same story as the few female students in the elective science class…… Then we talk about inclusivity, it is not only for the females and male students' ratio, but we also have to move along with students who have special cases in the class.*

The above statements from one science tutor indicated that the use of gender responsive pedagogies had influence in the participation of female student teachers in science lessons. As shown in Table 6, the overall mean score and standard deviation for the extent to which tutors use pedagogies in the new B.Ed. curriculum in teaching science was 1.94 (SD^2 .25). This shows that tutors' overall use of pedagogies in the new B. Ed curriculum is great. This is corroborated by the interview conducted where

tutors indicated that they have been using the pedagogies in the new B. Ed curriculum to a great extent in their teaching. For example, a tutor had this to say when asked about what pedagogies he used recently in his teaching.

> *During T TEL workshops that is; professional development sessions, we learnt about the recommended strategies we should use to teach this new B. Ed. programme…so I used groupwork, computer presentations, pyramid discussion and e-learning strategies, self and peer strategy to assess the students in my recent lesson…so, for now yeah it is that one. As for knowledge, we (tutors) are supposed to acquire knowledge continuously but the professional practice which deals with how to use it in classroom situation, I will say for now we are using it.*

The above except showed that tutors know and use some of the recommended pedagogies in their classrooms.

Another tutor said that, –Engaging them (students) in group activities for them to discuss among themselves and give presentation on what they have discussed in their groups make the lesson interesting…. that was what I used". These comments were indications that tutors use the recommended pedagogies in delivering their lessons in the classroom. Apart from the questionnaire, the researcher made observation to authenticate responses made by science tutors to the closed-ended items (quantitative) of the questionnaire. An observation checklist was used to monitor the tutors claims to using the recommended pedagogies in their lessons. The strategies were arbitrary assigned to groups A- E for facilitate analysis and interpretation of the data. Lessons of five science tutors were observed by the researcher to ascertain their use of the recommended pedagogies in the new B Ed curriculum are presented in Table 6.

Table 6: Percentage Frequency Distribution on tutors' use of Strategies and Pedagogies in the new B.Ed. Curriculum in their Science Lessons

	Items	Frequency Yes	%	Frequency No	%
A	1. Begins lesson with starter/energizer	1	4	4	16
	2. Identify possible misconceptions of lesson that pre-service teachers may bring to class	2	8	3	12
	3. Uses multimedia in teaching	3	12	2	8
	4. Uses simulations in teaching	0	0	5	20
	5. Uses videos in teaching	2	8	3	16
	Total	**8**	**32**	**17**	**68**
B	6. Uses computer presentations	5	20	0	0.0
	7. Uses science related games	4	16	1	4
	8. Uses rhymes and songs	4	16	1	4
	9. Uses concept maps	3	12	2	8
	10.Uses concept cartoons	2	8	3	12
	Total	**18**	**72**	**7**	**28**
C	11. Uses laboratory activities	5	20	0	0
	12. Uses modelling	5	20	0	0
	13. Uses storytelling	4	16	1	4
	14. Uses groupwork	5	20	0	0
	15. Uses PowerPoint presentations	5	20	0	0
	Total	**24**	**96**	**1**	**4**
D	16. Uses seminar	4	16	1	4
	17. Uses inclusion	3	12	2	8
	18. Uses gender responsive pedagogy	5	20	0	0
	19. Uses reflective practices	4	16	1	4
	20. Guides preservice teachers to present models for assessment	5	20	0	0
	Total	**21**	**84**	**4**	**16**
E	21. Uses assignments to assess preservice teachers	5	20	0	0
	22. Uses quizzes to assess preservice teachers	5	20	0	0
	23. Uses tests to assess preservice teachers	5	20	0	0
	24. Assesses preservice teachers based on the NTS	5	20	0	0
	25. Guides preservice teachers to develop portfolio	5	20	0	0
	Total	**25**	**100**	**0**	**0**
	Mean Score	**3.9**	**100**	**1.6**	**100**
	Standard deviation	**6.8**			

From Table 6, it can be seen that majority of the science tutors did not use pedagogies/strategies coded –A". Total frequency of strategies observed to have been used in –A" was 8(32%) and total frequency of the strategies and pedagogies that was not observed to have been used was 17(68%). Consequently, majority of the strategies

and pedagogies with the frequency of 21(84%), 24(96%) and 25(100%) were observed to have been used in the items coded D, C and E respectively in table.

Few of the pedagogies and strategies in the items coded D, C and E were not observed to have been used by the science tutors. On the whole, science tutors sampled for the observation obtained overall mean frequency score of 3.9 for strategies observed to have been used and 1.6 for strategies not observed to have been used. The mean for strategies observed to have been used was of 3.9 which is clearly above the standard mean of 1.5. This implied that tutors use of the recommended pedagogies and strategies in the B.Ed. curriculum was high. Tutors who did not use the recommended pedagogies frequently scored (1.6). The mean of 1.6 representing the frequency of strategies and pedagogy which was not observed to have been used by the science tutors is slightly higher than the Standard Mean (1.5). This meant that most of the strategies/pedagogies recommended in the curriculum were not frequently used by tutors in the science lessons. The non-frequent use of the pedagogies by the tutors as shown in the items coded A could be attributed to several factors including inadequate teaching and learning resources, the self-efficacy of the science tutors and the suitability of the strategies not used to the lessons observed.

Tables 6 and 7 clearly suggest that responses of the science tutors to the online questionnaire (Section C) did not fully correspond to the observed practices in the cases of some strategies and pedagogies. The indication is that the science tutors may have acquired knowledge about recommended pedagogies during the activities of T-TEL PDS but did not use all of them in their classrooms as recommended in the new B.Ed. curriculum. This means that the positive and improved learning outcomes that should have been acquired by their pre-service teachers through them would not be

fully realised. In this case, meeting the requirement of the NTS and improved learning outcomes of basic school pupils in Ghana would therefore be difficult to achieve.

4.4 Research Question Three: What factors affect science tutors' use of the recommended pedagogies in the new B.Ed. Curriculum?

The research question sought to identify the factors that affected tutors' effective use of the pedagogies as recommended in the new B Ed curriculum. Interview which comprised of open-ended items was used to obtain qualitative data to answer the question. The interviews were conducted on five science tutors at E.P. College of Education only, to solicit information about factors that affect tutors' effective use of the pedagogies as recommended in the new B Ed curriculum. Consequently, items 8, 9 and 10 of the interview guide (Appendix B) sought information about factors that affect science tutors' use of recommended pedagogies in their classroom. Three tutors were interviewed face-to-face and the other two tutors were interviewed through phone calls. Permission was sought from the participants to audio record the both face-to-face and phone calls interviews.

From the analysis of the interview data, it was identified that the factors that affect tutor's use of the pedagogies could be put into two categories, positive and negative factors. The positive factors, included the commitment of school leadership, support of professional development team and self-efficacy on the part of tutors. Tutors opined that they were able to use the pedagogies in the new B Ed curriculum because of the support from college leadership who provided the resources such as projectors, computers, internet connectivity among others.

For example, a tutor indicated that:

> *…before the curriculum reform in the colleges, most of us did not know how to integrate ICT tools like projectors and computers into our teaching, so there were few projectors (3 – 4) and computers…now we have learnt it. So, college leadership purchased more projectors and computers…at least one projector and computer to a department.*

The Professional Development team which comprises local tutors who are called Professional Development Coordinators and –critical friends" provided tutors with the needed support in the form of feedback, recommendations and suggestions. Another tutor commenting on their support stated that:

> *Although we learnt about the recommended pedagogies in the new B Ed curriculum in professional development sessions…… but we could still consult the PDCs when you have a challenge in the use of a particular strategy. Sometimes our critical friends come to the classrooms to observe our lessons and point out the observed mistakes.*

The following factors were identified to have negative influence on tutors' use of the pedagogies in the new B.Ed. curriculum:

i. Tutors' unwillingness to change,

ii. Tutors' perception that there is nothing new to learn in the PDS,

iii. Inadequate resources,

iv. Inadequate time.

During the interview, a tutor commented that;

> *You see, change is very difficult. There are people (tutors) who have learnt how to use the pedagogies to teach at the Professional Development Sessions but you go to their classroom and they are still doing the old things because they are unwilling to change. This also affect the kind of impact we want to see.*

The excerpt above supported the findings that tutors' unwillingness to change is one of the factors that affect tutors use of recommended pedagogies which has the potential of affecting implementation of the B.Ed. curriculum for Colleges of Education.

On inadequate resources, it was indicated by one tutor that "... we are required to integrate ICT tools like projectors into our teaching but if you go to the classroom and these resources are not there, it does not allow us use the pedagogies as recommended very well". One tutor lamented how tutors' perception about the professional development sessions is negatively affecting the use of the recommended pedagogies in the new B Ed curriculum by saying that;

> *you see some tutors also have the perception that these things we are learning, are from other countries and they want to just dump it on us. Some people want to use us to make money somewhere and we are now being used to experiment other people's ideas.*

Some of the tutors identified inadequate time as also affecting the effective use of the recommended pedagogies in the B Ed curriculum. A tutor had this to say:

> *The track system where some group of students have to be at home while other group come to take lectures on campus. This semester for example, we have activities such as sporting activities and orientations for STS among others. As we speak now, the students have lost about six hours today because they have to go to take their students' ID cards at the ICT centre. So, the inadequacy of time is really affecting the use of pedagogies.*

Policies such as assessment and procurement were also identified to impact negatively on their use of the pedagogies. One tutor asserted this point by saying that,

> *There is also this issue about policy like assessment. If we teach using T-TEL approaches but the end of the semester graded by a different body without sometimes taking continuous assessment scores into consideration, do you think it will not affect the use of the recommended pedagogies? It will. Honestly speaking the summation of the CA scores and External Examination scores for some students gave the total scores of 20, 23, 25, ...the question is, did the CA marks play a significant role in this case...if we are to strictly go by*

> *the recommended pedagogies, we can't finish the course outline. So sometimes we have to use the lecture technique so that our students can pass the end of semester exams.*

Comments such as the excerpt above given by tutors signified that the nature of the assessment used at the Colleges is factor which significantly would affect the use of the recommended pedagogies. The focus of the tutors and student teachers are still on passing the end of semester examination and they would not mind sacrificing the use of the recommended pedagogies for the exams. The use of the traditional techniques in place of the recommended pedagogies in the manner described above could make difficult for the aims of the B.Ed. programme for Colleges of Education to be achieved.

Similarly, the issue of long procurement processes of teaching and learning resources from college management is a factor that seriously influences the implementation of recommended pedagogies as indicated by a tutor in response to the interview question: What do you think are some of the barriers that impede the effective use of pedagogies espoused in the new B. Ed curriculum? The tutor commented that:

> *In fact, I had to substitute laboratory practical/experiment with a video before I could teach a topic under tests and identification of functional groups all because of long processes and delay on the part of procurement procedures and requirement.*

Although tutors have the liberty to select and use whatever strategies or pedagogies, they consider appropriate for teaching, the use of videos cannot produce the same effects as practical lessons with student teachers. The choice of videos over a practical lesson was influenced by the absence of the needed materials for teaching.

Another tutor had this to say:

> *I equally encountered an issue with the procurement unit because they procured an item for me which did not match with the specification I requested for. And when I queried them, they gave a reason which I considered as fiasco. Frankly speaking, I was not able to use the item for the intended purpose.*

The above excerpts showed that, procurement related issues at the colleges of education constituted one of the factors that influenced tutors use of recommended pedagogies in the new B.Ed. curriculum. The supply of the right material requested enhances the tutors' use of pedagogies as recommended in the curriculum. Where inappropriate materials are provided by the college authorities as in the situation of the tutor's comment above, it leads to frustrations and slow down the desire of tutors to implement the curriculum as expected.

4.5 Discussion of Findings

This section of the research report discusses the findings of the study in line with the themes formulated from the research questions. The themes are:

1. Science Tutors' knowledge about the recommended pedagogies in the B.Ed. Curriculum
2. Science Tutors use of the recommended pedagogies in their classroom practices
3. Factors that affect Science Tutors' use of the recommended pedagogies in the implementation of new B.Ed. Curriculum

4.5.1 Science Tutors' Knowledge about Pedagogies in the New B. Ed Curriculum

The overall responses of tutors to items on the Section B of the questionnaire and items 8, 9 and 10 of the Interview Guide implied that science tutors had adequate knowledge about pedagogies in the new B Ed curriculum.

The findings from the qualitative data, that is, interview and open-ended items of the questionnaire, indicated that tutors‘ knowledge about pedagogies in the new B Ed Curriculum was good as discussed on items 8 and 9 on pages 68 and 69 of this report. Tutors indicated that the professional development sessions they attend on weekly bases have enhanced their understanding of the philosophy, structure and content of the new 4-year Bachelor of Education curriculum of which include the pedagogies, principles guiding learning outcomes and features of supported teaching in school. This is indicated in some tutors‘ excerpts such as:

> *We learnt about the recommended strategies and pedagogies we should use to teach this new B. Ed programme in Professional Development sessions, so I used groupwork, computer presentations, pyramid discussion and e-learning strategies, self and peer strategy to assess the students in my recent lesson…so, for now yeah it is that one. As for knowledge, we (tutors) are supposed to acquire knowledge continuously but the professional practice which deals with how to use it in classroom situation, I will say for now we are using it.*

This means that the tutors understand the philosophy, the practical backing and the use of the pedagogies in the new B.Ed. curriculum. The findings also mean that the tutors understand the NTECF and its implications on their works as tutors (Coffie, 2020). The responses therefore meant that tutors had good knowledge about pedagogies in the B.Ed. curriculum. This therefore calls on tutors to use their knowledge about the recommended pedagogies for the benefit of the B.Ed. programme. According to Putnam and Borko (2000), effective use of the pedagogies in teaching depends on well-organized and integrated knowledge from different domains including student reasoning and learning knowledge, subject matter, and most importantly, pedagogical knowledge. Some tutors however, expressed diverse views of their knowledge about the recommended pedagogies during the interview.

One tutor for instance, stated that:

> *For the knowledge and effective use of the 4-year B. Ed curriculum, we have started implementing it not too long. I am not very conversant with it yet…. we are still learning about the pedagogies during professional development in which tutors are taken through for them to gain adequate knowledge to effectively teach the B.Ed. curriculum. For example, the idea about NTS and Supported Teaching in Schools in the 4-year B.Ed. curriculum are all new reforms in the Ghanaian Educational Sector for which all categories of tutors will need to be abreast with.*

This comment showed that they were few other tutors who had challenges in understating and using the recommended pedagogies in the classroom. This situation can really affect the implementation of the curriculum as such tutors may not apply the pedagogies to their teaching in the classroom. Such tutors if not identified and supported by the authorities they would stick to the use of outdated teaching strategies to the disadvantage of the B.Ed. programme. This showed up in the observation of the study where the frequency of strategies used by tutors was far below expected as in the group of items coded –A" in page 75 of this report. Shuilleabhain (2016) reported teachers' who lack adequate pedagogical knowledge would have negative influence on their use of pedagogies.

4.5.2 Science Tutors use of the recommended pedagogies in their classroom practices

The recommended pedagogies in the new B.Ed. curriculum are designed with the aim of promoting the use of integrative, collaborative, reflective, interactive and learner-centred approaches that facilitate greater learning outcomes of student teachers. The current experience in colleges showed that these pedagogies/strategies are helping science tutors prepare pre-service teachers for improved classroom teaching, greater interaction, participation of pupils in lessons and above all, to meet the requirement of the NTS. This view is also held by Yap, et. al. (2016) when they reported that the

use of interactive and learner-centred pedagogies had a great impact on students learning.

Persaud (2019) also outlined the different types of pedagogies as social pedagogy, critical pedagogy, culturally-responsive pedagogy and Socratic pedagogy all of which are catered for in the new B.Ed. curriculum. The findings from both the qualitative and quantitative data indicate that tutors use pedagogies in the new B. Ed. curriculum to a moderate extent in the teaching of science at the E.P. College of Education and Tamale College of Education in the Northern Region of Ghana. This is supported by tutors' responses on Table 6 where the overall mean score of 1.94 (SD^2 0.25) indicated moderate use of the pedagogies in the new B.Ed. curriculum by the tutors in teaching science. The implication of this findings of moderate use of pedagogies by the tutors is that the college authorities should double their efforts at dealing with the factors that hinder the use of the pedagogies by tutors else, full implementation of the curriculum may not be accomplish. The colleges of education have the core mandate to train teachers for the basic level of education. This level of education needs interactive and learner-centred approaches in teaching. It is therefore expected that college of Education tutors will use interactive and learner-centred instructional strategies and pedagogies in teaching the preservice teachers who will also teach using these learner-centred approaches as they have experienced in their training.

The recommended pedagogies in the New B.Ed. Curriculum were designed for college tutors to use interactive teaching approaches in teaching and training the students who will learn from their tutors (T-TEL, 2017). From the interview conducted, tutors' responses showed that their teachings are interactive and learner-centred as they involved the student teachers in lessons through group and individual

presentation and meaningful discussions. This had led some of the student teachers to had been observed employing such approaches in their teaching practices on attachment programmes. For example, a tutor said that:

> *My teaching for now is more interactive as compared to my previous teaching experience. At first, I will take a topic and go through all aspects without giving students the opportunity…. but now, I involve the students in most of the teaching and learning activities in the classroom. Topics that I used to handle entirely on my own, now the students also come in to share their experience through group discussion and presentations and I also become a student learning from them, so we all learn from each other.*

The above extract summaries the effects of the recommended pedagogies on tutors and students. The comments suggests that both the tutor and the student teachers are involved in cooperative learning which is recommended by the curriculum. It also indicated the use of pedagogical strategies such as collaborative and integrative which are student-centred. Another tutor also indicated the extent to which he uses the pedagogies by saying —. because my students are doing well in terms of how I am using the recommended approaches (pedagogies) in the new B Ed curriculum. And some students are also using the pedagogies in their teaching practice.‘‘ This response supports Gabel (2003) asserts that, how well students gain a conceptual understanding of science is related to how their teachers teach science.

The findings show that, tutors are able to use gender responsive pedagogies and inclusivity strategies to involve preservice teachers interactively in science classrooms at both E. P. College of Education, Bimbilla and Tamale College of Education. This result supports a study by T-TEL (2017) which was carried out to examine the impact of T-TEL programmes in the colleges in which it was concluded that ~~a~~ growing number of tutors have mastered the use of student-focused teaching methods and gender-responsive instructional strategies”.

4.5.3 Factors that affect Science Tutors' use of the recommended pedagogies in the implementation of new B.Ed. Curriculum

From the interview data, it came out that some contextual factors affect tutors use of pedagogies in the B.Ed. curriculum both positively and negatively. These factors would either promote tutors use of the recommended pedagogies or prevent them from using the pedagogies in their classroom. The major contextual factors identified were:

i. Leadership Commitment/Support
ii. Self-efficacy/ Personal Context of tutors
iii. Inadequate Resources/ Time
iv. Procurement related challenges
v. School policies

The commitment of leadership is a critical contextual factor in the use of pedagogies by tutors. Leadership commitment translates to the provision of key resources for teaching such projectors, computers, internet connectivity and so on, to aide in their use of the recommended pedagogies. It was in line with responsibility of leadership that a tutor said following:

> *…most of us did not know how to use technologies like projectors and computers in our classrooms, so there were few projectors (3 – 4) and computers for only those who could use them……. now we have learnt it. So, college leadership purchased more projectors and computers…at least one projector and computer to a department.*

The extract highlighted the commitment of leadership to the programme by providing the needed resources to back the implementation of the curriculum. Where the such critical resources are lacking or inadequate, the leadership commitment is questioned by the tutors and that can greatly affect the use of the recommended pedagogies. The findings confirm Tarling and Ng'ambi (2016), asserted that, the context within which pedagogies are

used affects its content, process and impact. The study further revealed that the commitment of the school leadership as well as the support of the professional development coordinators were factors that affected the use of pedagogies positively. Effective school leadership and collective commitment has been noted by Day, et. al. (2020) to affect teachers' effective use of pedagogies. Leadership has an important effect on school organisation, culture, teachers and student learning. Leadership at the college has indirect effects in promoting student learning outcomes, enhancing conditions for teaching and learning and impacting on tutors' use of pedagogies.

Tutors reported during the interview that their use of the recommended pedagogies in the teaching of science at the College was due to the commitment of the leadership of the College who ensured that professional development is part of the weekly activities for tutors of the colleges and to some extend provided the resources/materials required for tutors to implement what (the pedagogies) is learnt in their classroom. Support was identified to be a major factor that positively affected the effective use of the pedagogies. According to Guskey (2002), providing follow-up and support in implementing new skills, are parts of professional development that are associated with increased use of new instructional practices. Therefore, the support which was provided in a form of feedback, suggestions and recommendations by the professional development coordinators and other teaching staff enabled the science tutors to gain knowledge and use the pedagogies in teaching science. Dede (2007), suggested that providing opportunities for teachers to get support and mentorship during teaching makes the use of new pedagogies effective. The findings of this study support Afshari, et. al. (2009) opinion that, the support of school administration and cooperation of staff were some of the factors that influenced teachers' use of new pedagogies. The findings also support the work of Supovitz and Turner (2000) who

identified support of the school principal as a factor that affected teachers‘ capacity to apply reform practices in their classroom, in which one tutor says:

> *...we have to commend our principal for his constant reminders on the need for the Professional Development Coordinator to organise us to always attend Professional Development Sessions…. initially, I thought he wanted to use us for money, but I later realised the good part of his reminders and stuff. He is doing that in our own interest to shape our teaching and learning practices.*

However, this finding disagreed with Kannapel, et. al. (2001) who attributed teachers‘ inability to practice ideas learnt in professional development programme to a lack of follow-up support after the programme. In this present study, the principal gives follow-up support as and when the need arises. Although, science tutors attest to the fact that they get positive support from college leadership, this does not guarantee the highest extent of use of the recommended pedagogies in the new B.Ed. Curriculum. However, it serves as a starting point for their willingness to upgrade their knowledge and a better position to teach.

Another factor which affects the use of pedagogies identified by the study was tutors self-efficacy and personal context. Tutors‘ use of the pedagogies was affected by their personal context and institutional factors. Tutors‘ personal context and institutional factors which were identified to have negatively influenced their use of the pedagogies in the new B Ed curriculum included:

- Their unwillingness to change,
- Tutors‘ perception that there was nothing new to learn and/or they needed only to be present since every tutor was supposed to attend the programme,
- Tutors‘ self-efficacy,
- Inadequate resource and time.

As a science tutor, the researcher‘s personal observation of tutors‘ lessons during observations of the lessons, indicated that majority of the science tutors used some of the recommended pedagogies in the new B.Ed. Curriculum with few challenges of inadequate resources. This might be due to the procurement associated challenges as indicated earlier by tutors. However, there was a small number of tutors who did not use some of the recommended pedagogies during the lesson observation.

It was found out that unwillingness of some of the tutors to change was a factor that negatively affected the use of the pedagogies. This was in consonance with Ertma (2005) findings that, trying to change the teaching practices of teachers is a very difficult task to achieve because the process requires concerted efforts. For change in teaching practice to occur, there must be a balance between teachers‘ ―pedagogical discontentment” i.e., the degree to which teachers are dissatisfied with their teaching practice and want to change and their self-efficacy (Southerland, et. al., 2016). This implies that some of the tutors are satisfied with their old teaching practices and do not have the belief that it can be changed. They are therefore holding on to their old teaching practice despite being introduced to reform practices.

One factor that has consistently been mentioned to have strong influence on the use of pedagogies in the new B.Ed. curriculum is resources. Some of reasons why tutors‘ use of the pedagogies is considered quite ineffective are that some of the recommended pedagogies present ideas that cannot be practicalized because of inadequate resources (Barnett & Hodson, 2001). The absence of laboratory equipment and materials necessary for science practical lessons in colleges of education made some of the tutors to use other strategies other than laboratory experiments recommended in the curriculum. The use of videos as a substitute for hands-on practical activities by the

tutors in science lessons had the tendency to deny student teachers the opportunity to acquire practical skills.

It was found that inadequate and, in some cases, total absence of resources such as science laboratory and technological tools like projectors were some of the factors influencing negatively on tutors‘ use of pedagogies in the new B.Ed. curriculum. This confirms the findings of Penuel, et. al. (2007) who found that resources like tools and technology had significant influence on the implementation, teacher knowledge and changes in science teachers‘ practices. Supovitz and Turner (2000) also found available resources such as teaching aids, time to design and prepare lesson, and availability of science relevant supplies, also have a statistically significant influence on teachers‘ practices.

The result from the interviews showed that inadequate time on task is negatively affecting the use of the recommended pedagogies, of which a tutor indicated that:

> *This semester for example, we have lots of events taking place such as sporting activities, orientations for STS, SRC Week Celebration among others. As we speak now, the students have lost about six hours today because they have to go to take their students' ID cards at the ICT centre and stuff. In line with these, we lose many contact hours with our students and in the long run, one may have to resort to lecture in order cover many content areas. So, the inadequacy of time is really affecting the effective use of pedagogies.*

This research finding is similar to Nehls, et. al. (2020) who concluded that, the small extent to which some tutors use pedagogies has been attributed to some pedagogies loaded with many activities which expected to be carried within a very short time. In the same vein, Bruce, et. al. (2010) found that the more activities embedded in a pedagogy the more likely that other factors could influence the outcome. They further argue that pedagogies which require long period to execute a task like project work

could cause teachers to lose interest in its usage. The implication is that science tutors would most likely use the recommended pedagogies in teaching science in Colleges of Education on if adequate resources are available to them.

Procurement related challenges are factors that hinder the use of pedagogies in the Colleges of Education. This is highlighted in the responses under research question 3 of this study where the extract of the tutor interview indicated that procurement related issues constituted one of the factors that influenced his use of the recommended pedagogies. in the new B.Ed. The in this study tutor reported that he used videos instead of practical lessons because of procurement challenges. He noted that procurement delays do make possible for the right materials to be provided on time. Besides delays of supplies, where inappropriate materials are provided by the college authorities as in the situation of the tutor interviewed, it leads to frustrations and reduces the desire of tutors to implement the curriculum.

School policies such as assessment techniques used by colleges of education and their universities to which they affiliate affects the use of pedagogies by tutors. The view expressed by tutors under the research question 3 confirmed the impact of college assessment policies on the use of pedagogies recommended in the B.Ed. Curriculum. The statement of the tutor was indicative of the attention paid by tutors and student teachers to examinations which are externally set and graded. This factor of examination made the tutor to use traditional teaching techniques like lecture just to cover the course outline and prepare the student teachers for the exams.

Implementing these recommended strategies and pedagogies in their classroom practices would most likely bring about positive learning outcomes of student teachers if the factors identified are addressed. The student teachers during their

extended teaching practice and teaching after completing college would in turn most likely use the pedagogies. This would lead to improved learning outcomes of basic school learners in Ghana which are the main aims of the new B.Ed. curriculum, The learning settings in Ghanaian basic schools would gradually change from teacher-centred pedagogies to innovative learner-centred strategies which allow learners to have more control over their own learning, to think analytically and critically and to work collaboratively.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDIES

5.0 Overview

This chapter of the study focused on the summary, conclusions drawn from findings, recommendations made based on the conclusions and the finding. Few suggestions for further studies were also made.

5.1 Summary of the Study

The main purpose of this research was to assess Science Tutors‘ knowledge and use of pedagogies in the new B Ed curriculum for colleges of education in Ghana. The study was guided by the under-listed research questions.

1. What is the level of science tutors‘ knowledge about pedagogies in the new B. Ed Curriculum?
2. How well do science tutors use pedagogies in the New B. Ed Curriculum in their teaching practices?
3. What factors affect science tutor‘s effective use of the pedagogies as spelt out in the new B.Ed. Curriculum?

The study employed a case study design to assess science tutors‘ knowledge and use of pedagogies in the new B Ed curriculum for the Colleges of Education in Ghana. An online survey was conducted, followed by interview and observation checklist with some of the science tutors. The survey data and observation checklist were analysed using means, standard deviations and simple frequency respectively. Data from the interview was also analysed thematically.

5.2 Main/Key Findings

The key findings of the study are as follows;

1. Tutors' knowledge about recommended pedagogies in the new B Ed curriculum was adequate. The tutors used gender responsive and inclusivity strategies among others to actively engage student teachers in lessons observed.
2. Tutors were able to use recommended pedagogies in the new B Ed curriculum to a moderate extent in science teaching at the E P College of Education, Bimbilla and Tamale College of Education. However, the study revealed that the external assessment and grading procedures of the Colleges of Education especially the end of semester questions are sometimes not reflective of the new methodologies.
3. Besides motivation, inadequate teaching resources such projectors, laboratory equipment, regents, furniture and space were identified as key factors that affect science tutors use of the recommended pedagogies. Also, unwillingness of tutors to change, tutors' perception and assessment policies were some of the factors that negatively influenced the tutors use of pedagogies as prescribed in the new B Ed curriculum for colleges of education in Ghana.

5.3 Conclusions

The study revealed that tutors had adequate knowledge about the recommended pedagogies in the new B.Ed. curriculum although they did not use the pedagogies to a great extent. Despite this, observation indicated that the tutors had high knowledge level of the recommended pedagogies and therefore poised to effectively implement the curriculum.

It was observed that tutors were conscious of inclusivity, gender and equity issues during their science lessons. Therefore, if the student teachers who are being trained

by these tutors would learn these pedagogies from their tutors and effectively use them, teaching at the basic schools would be more interactive and learner-centred.

A number of institutional and tutor factors were identified as obstacles to the tutors' curriculum would seriously be hampered if these factors are not addressed to ameliorate the pedagogical practices. The efforts of the tutors' implementation of the intention.

5.4 Recommendations

The study recommended the following:

1. The study revealed that the science tutors had adequate knowledge of the recommended pedagogies. However, were unable to use some of the pedagogies in their lessons when they were interviewed. It is therefore recommended that the sources of their inability to use such pedagogies should be identified and addressed during the weekly professional development sessions.
2. The study showed that a number of factors affected science tutors' use of the recommended pedagogies. These included inadequate teaching resources such as projectors, laboratory equipment, regents, furniture and space. It is recommended that management of the Colleges should ensure that these critical resources are adequately provided on time to enhance the science tutors effective use of the new pedagogies.

5.5 Suggestions for further studies

1. Since this is case study and the findings cannot be generalised to the other 46 Colleges of Education in Ghana, the researcher suggests that a broader study is curried out on this critical issue of use of recommended pedagogies by science tutors.

2. The study was focused mainly on science tutors. However, the perceptions and attitudes of the student teachers are central to the use of the recommended pedagogies by the science tutors. These attitudes of the student teachers were not considered in this study. It would therefore be expedient to carry out a study on the preservice teachers‘ perception and attitudes towards the use of pedagogies in the new B Ed curriculum for Colleges of Education in Ghana to provide comprehensive picture of the implementation of the curriculum.

REFERENCES

Abma, T. A., & Stake, R. E. (2014). Science of the particular: An advocacy of naturalistic case study in health research. *Qualitative Health Research*, *24*(8), 1150-1161.

Abudulai, I. (2021). Student Teachers' Perspectives on Supported Teaching in School Programme in Colleges of Education in Ghana. *International Journal of Elementary Education,* 10(4), 100.

Adu-Yeboah, C., & Kwaah, C. Y. (2018). Preparing teacher trainees for field experience: Lessons from the on-campus practical experience in colleges of education in Ghana. *Sage Open*, *8*(4), 2158244018807619.

Afshari, M., Bakar, K. A., Luan, W. S., Samah, B. A., & Fooi, F. S. (2009). Factors affecting teachers' use of information and communication technology. *International Journal of Instruction*, *2*(1).

Aina, J. K., & Langenhoven, K. (2015). Teaching method in science education: the need for a paradigm shift to peer instruction (PI) in Nigerian schools. *International Journal of Academic Research and Reflection*, *3*(6), 6-15.

Ajayi, L. (2009). An exploration of pre-service teachers' perceptions of learning to teach while using asynchronous discussion board. *Journal of Educational Technology & Society,* 12(2), 86-100.

Alebna, V. I. C. T. O. R. (2019). *Mathematics tutors' level of participation in T-Tel professional development and their perceived self-efficacy beliefs to implement the bed Mathematics curriculum* (Doctoral dissertation, University of Education, Winneba).

Allday, R. A., Neilsen-Gatti, S., & Hudson, T. M. (2013). Preparation for inclusion in teacher education pre-service curricula. *Teacher Education and Special Education*, *36*(4), 298-311.

Alsubaie, M. A. (2015). Examples of current issues in the multicultural classroom. *Journal of Education and Practice, 6*(10), 86-89.

Anderson, W. M., & Campbell, P. S. (2010). Teaching music from a multicultural perspective. *Multicultural perspectives in music education*, *3*, 1-7.

Appova, A., & Arbaugh, F. (2018). Teachers' motivation to learn: Implications for supporting professional growth. *Professional development in education*, *44*(1), 5-21.

Armah, P. H. (2018). T-TEL Curriculum Reform Study.

Asenahabi, B. M. (2019). Basics of research design: A guide to selecting appropriate research design. *International Journal of Contemporary Applied Researches*, 6(5), 76-89.

Bacha, N. N. (2002). Developing learners' academic writing skills in higher education: A study for educational reform. *Language and Education*, *16*(3), 161-177.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special?

Barnett, J., & Hodson, D. (2001). Pedagogical context knowledge: Toward a fuller understanding of what good science teachers know. *Science Education*, *85*(4), 426-453.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report*, *13*(4), 544-559.

Bernstein, B. (2000). *Pedagogy, symbolic control, and identity: Theory, research, critique* (Vol. 5). Rowman & Littlefield.

Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking: a tool to enhance trustworthiness or merely a nod to validation? *Qualitative health research*, *26*(13), 1802-1811.

Blatchford, P., Kutnick, P., Baines, E., & Galton, M. (2003). Toward a social pedagogy of classroom group work. *International Journal of Educational Research, 39* (1-2), 153-172.

Boa, E. A., Wattanatorn, A., & Tagong, K. (2018). The development and validation of the Blended Socratic Method of Teaching (BSMT): An instructional model to enhance critical thinking skills of undergraduate business students. *Kasetsart Journal of Social Sciences, 39* (1), 81-89.

Bocskor, A., Hunyadi, M., & Vince, D. (2017). National Academies of Sciences, Engineering, and Medicine (2015) The Integration of Immigrants into American Society. Washington, DC: The National Academies Press. 458 pages. *Intersections: East European Journal of Society and Politics, 3*(3), 157-161.

Boghossian, P. (2004). *Socratic pedagogy, critical thinking, moral reasoning and inmate education: An exploratory study*. Portland State University.

Bruce, C. D., Esmonde, I., Ross, J., Dookie, L., & Beatty, R. (2010). The effects of sustained classroom-embedded teacher professional learning on teacher efficacy and related student achievement. *Teaching and Teacher Education*, *26* (8), 1598-1608.

Bryman, A., & Cramer, D. (2012). *Quantitative data analysis with IBM SPSS 17, 18 & 19: A guide for social scientists*. Routledge

Cakir, M. (2008). Constructivist approaches to learning in science and their implications for science pedagogy: A literature review. *International Journal of Environmental and Science Education*, *3*(4), 193-206.

Caruth, G. D. (2018). Student engagement, retention, and motivation: Assessing academic success in today's college students. *Participatory Educational Research, 5*(1), 17-30.

Caulfield, C., Xia, J. C., Veal, D., & Maj, S. (2011). A systematic survey of games used for software engineering education. *Modern Applied Science*, *5*(6), 28-43.

Chaudhary, G. K. (2015). Factors affecting curriculum implementation for students. *International Journal of Applied Research*, *1*(12), 984-986.

Chibueze, G. I., & Okoye, K. E. (2021). Relative effectiveness of cooperative and inquiry learning methods on students' academic achievement and retention in basic electricity. *Nau Journal of Technology and Vocational Education*, *6*(1), 208-218.

Chin, C. (2007). Teacher questioning in science classrooms: Approaches that stimulate productive thinking. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *44*(6), 815-843.

Chong, S., & Cheah, H. M. (2009). A values, skills and knowledge framework for initial teacher preparation programmes. *Australian Journal of Teacher Education (Online)*, *34*(3), 1-17.

Chow, J. Y., Teo-Koh, S. M., Tan, C. W. K., Button, C., Tan, B. S. J., Kapur, M., & Choo, C. Z. Y. (2020). *Nonlinear pedagogy and its relevance for the new PE curriculum*. Office of Education Research, National Institute of Education, Singapore.

Cobern, W. W., Schuster, D., Adams, B., Skjold, B. A., Muğaloğlu, E. Z., Bentz, A., & Sparks, K. (2014). Pedagogy of science teaching tests: Formative assessments of science teaching orientations. *International Journal of Science Education*, *36* (13), 2265-2288.

Coffie, I. S. (2020). *Perceived impact of continuous professional development programme on physics teaching at the Colleges of Education in Ghana* (Doctoral dissertation, University of Cape Coast).

Creswell, J. W., Klassen, A. C., Plano Clark, V. L., & Smith, K. C. (2011). Best practices for mixed methods research in the health sciences. *Bethesda (Maryland): National Institutes of Health*, *2013*, 541-545.

Day, C., Sammons, P., & Gorgen, K. (2020). Successful School Leadership. *Education Development Trust*, *6* (13), 265-288.

Dede, C. (2007). Transforming education for the 21st century: New pedagogies that help all students attain sophisticated learning outcomes. *Commissioned by the NCSU Friday Institute, February*, *6* (13), 26-28.

DeLuca, C., & Bellara, A. (2013). The current state of assessment education: Aligning policy, standards, and teacher education curriculum. *Journal of Teacher Education, 64*(4), 356-372.

Desimone, L. M. (2009). Improving impact studies of teachers‘ professional development: Toward better conceptualizations and measures. *Educational researcher*, *38*(3), 181-199.

Desimone, L. M., Smith, T. M., & Ueno, K. (2006). Are teachers who need sustained, content-focused professional development getting it? An administrator‘s dilemma. *Educational Administration Quarterly*, *42*(2), 179-215.

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education*, *40*(4), 314-321.

Diem, S., & Carpenter, B. W. (2012). Social justice and leadership preparation: Developing a transformative curriculum. *Planning and Changing, 43*, 96-112.

Draugalis, J. R., & Plaza, C. M. (2009). Best practices for survey research reports revisited: implications of target population, probability sampling, and response rate. *American Journal of Pharmaceutical Education*, *73*(8).

Drexler, W. (2010). The networked student model for construction of personal learning environments: Balancing teacher control and student autonomy. *Australasian Journal of Educational Technology*, *26*(3).

Eberlein, T., Kampmeier, J., Minderhout, V., Moog, R. S., Platt, T., Varma-Nelson, P., & White, H. B. (2008). Pedagogies of engagement in science: A comparison of PBL, POGIL, and PLTL. *Biochemistry and Molecular Biology Education, 36*(4), 262-273.

Ebert-May, D., Derting, T. L., Hodder, J., Momsen, J. L., Long, T. M., & Jardeleza, S. E. (2011). What we say is not what we do: Effective evaluation of faculty professional development programs. *BioScience*, *61*(7), 550-558.

Eccles, J. S., & Roeser, R. W. (2011). Schools as developmental contexts during adolescence. *Journal of Research on Adolescence, 21*(1), 225-241.

Erdogan, S. C. (2017). Science Teaching Attitudes and Scientific Attitudes of Pre-Service Teachers of Gifted Students. *Journal of Education and Practice*, *8*(6), 164-170.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25-39.

Esia-Donkoh, K., & Quansah, D. K. (2021). Leadership styles of principals based on setting, zone, and location of public colleges of education in Ghana. *Education Quarterly Reviews*, *4*(2).

Farrow, R. (2017). Open education and critical pedagogy. *Learning, Media and Technology, 42*(2), 130-146.

Friesen, K. L., & Stephens, C. M. (2016). Circles of Learning: Applying Socratic Pedagogy to Learn Modern Leadership. *Journal of Leadership Education*, *15*(1).

Friesen, S., & Scott, D. (2013). Inquiry-based learning: A review of the research literature. *Alberta Ministry of Education, 32*. 78-88.

Gabel, D. (2003). Enhancing the conceptual understanding of science. *Educational Horizons*, *81*(2), 70-76.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, *38*(4), 915-945.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report*, *8*(4), 597-607.

Goodwin, A. L. (2010). Globalization and the preparation of quality teachers: Rethinking knowledge domains for teaching. *Teaching Education, 21*(1), 19-32.

Gordon, M. (2009). Toward a pragmatic discourse of constructivism: Reflections on lessons from practice. *Educational Studies*, *45*(1), 39-58.

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching: Theory and Practice, 15*(2), 273-289.

Guskey, T. R. (2002). Professional development and teacher change. *Teachers and Teaching*, *8*(3), 381-391.

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education, 43*(3), 211-229.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education, 41*(4), 393-416.

Healey, M., & Jenkins, A. (2000). Kolb's experiential learning theory and its application in geography in higher education. *Journal of Geography*, *99*(5), 185-195.

Hudson, P. (2013). Strategies for mentoring pedagogical knowledge. *Teachers and Teaching, 19*(4), 363-381.

Hurst, R. M., Mitchell, J. T., Kimbrel, N. A., Kwapil, T. K., & Nelson-Gray, R. O. (2007). Examination of the reliability and factor structure of the Autism Spectrum Quotient (AQ) in a non-clinical sample. *Personality and Individual Differences*, *43*(7), 1938-1949.

Ismail, A., Hassan, R., & Rosli, D. I. (2017). The Skill and Competency of Technical and Vocational Education and Training (TVET) Personnel for the Development and Implementation of a National Teacher Standard in TVET in Malaysia. *Pertanika Journal of Social Sciences & Humanities*, *23*, 15-16.

Israel, S. E., Bauserman, K. L., & Block, C. C. (2005). Metacognitive assessment strategies. *Thinking Classroom*, *6*(2), 21.

Ivankova, N. V., & Creswell, J. W. (2009). Mixed methods. *Qualitative research in applied linguistics: A Practical Introduction*, *23*, 135-161.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational researcher*, *33*(7), 14-26.

Kannapel, P. J., Aagaard, L., Coe, P., & Reeves, C. A. (2001). Chapter XII: The Impact of Standards and Accountability on Teaching and Learning in Kentucky1. *Teachers College Record*, *103*(8), 242-262.

Kazempour, M., & Sadler, T. D. (2015). Pre-service teachers' science beliefs, attitudes, and self-efficacy: A multi-case study. *Teaching Education*, *26*(3), 247-271.

Khalil, M. K., & Elkhider, I. A. (2016). Applying learning theories and instructional design models for effective instruction. *Advances in Physiology Education*, 40(2), 147-156.

Kharb, P., Samanta, P. P., Jindal, M., & Singh, V. (2013). The learning styles and the preferred teaching—learning strategies of first year medical students. *Journal of Clinical and Diagnostic Research: JCDR, 7*(6), 1089.

Kim, Y. S. G. (2020). Hierarchical and dynamic relations of language and cognitive skills to reading comprehension: Testing the direct and indirect effects model of reading (DIER). *Journal of Educational Psychology*, *112*(4), 667.

Klein, E. J., & Riordan, M. (2009). Putting professional development into practice: A framework for how teachers in expeditionary learning schools implement professional development. *Teacher Education Quarterly*, *36*(4), 61-80.

Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). The technological pedagogical content knowledge framework. In *Handbook of research on educational communications and technology* (pp. 101-111). Springer, New York, NY.

Korthagen, F. A. (2016). Pedagogy of teacher education. *In International Handbook of teacher education* (pp. 311-346). Springer, Singapore.

Krajcik, J., Marx, R., Blumenfeld, P., Soloway, E., & Fishman, B. (2000). *Inquiry Based Science Supported by Technology: Achievement among Urban Middle School Students*.

Lam, B. H., & Tsui, K. T. (2016). Curriculum mapping as deliberation–examining the alignment of subject learning outcomes and course curricula. *Studies in Higher Education, 41*(8), 1371-1388.

Lefstein, A., Vedder-Weiss, D., Tabak, I., & Segal, A. (2018). Learner agency in scaffolding: The case of coaching teacher leadership. *International Journal of Educational Research*, *90*, 209-222.

Likoko, S., Mutsotso, S., & Nasongo, J. (2013). The adequacy of instructional materials and physical facilities and their effects on quality of teacher preparation in emerging private primary teacher training colleges in Bungoma County, Kenya.

Loughran, J. (2013). Pedagogy: Making sense of the complex relationship between teaching and learning. *Curriculum Inquiry*, *43*(1), 118-141.

Lupton, M. (2012). Inquiry skills in the Australian curriculum. *Access*, *26*(2), 12-18.

Marsh, C. J. (2007). A critical analysis of the use of formative assessment in schools. *Educational Research for Policy and Practice*, *6*(1), 25-29.

Mellom, P. J., Straubhaar, R., Balderas, C., Ariail, M., & Portes, P. R. (2018). –They come with nothing:" How professional development in a culturally responsive pedagogy shapes teacher attitudes towards Latino/a English language learners. *Teaching and Teacher Education, 71*, 98-107.

Mensah, F., Bassaw, T. K., Bordoh, A., & Eshun, I. (2014). Evaluation of social studies students' learning using formative assessment in selected Colleges of Education in Ghana. *British Journal of Education*, *2*(1), 39-48.

Mertler, C. A., Vannatta, R. A., & LaVenia, K. N. (2021). *Advanced and multivariate statistical methods: Practical application and interpretation*. Routledge.

Musingafi, M. C., Mhute, I., Zebron, S., & Kaseke, K. E. (2015). Planning to Teach: Interrogating the Link among the Curricula, the Syllabi, Schemes and Lesson Plans in the Teaching Process. *Journal of Education and Practice*, *6*(9), 54-59.

Myftiu, J. (2015). Individual Differences Considering Students' Learning Styles. *Mediterranean Journal of Social Sciences*, *6*(3 S1), 214-214.

Nbina, J. B. (2012). Analysis of poor performance of senior secondary students in chemistry in Nigeria. *African Research Review*, *6*(4), 324-334.

Nehls, C., König, J., Kaiser, G., & Blömeke, S. (2020). Profiles of teachers' general pedagogical knowledge: Nature, causes and effects on beliefs and instructional quality. *ZDM*, *52*(2), 343-357.

Ngozwana, N. (2018). Ethical dilemmas in qualitative research methodology: Researcher's reflections. *International Journal of Educational Methodology*, *4*(1), 19-28.

Ottesen, E. (2007). Reflection in teacher education. *Reflective practice*, *8*(1), 31-46.

Panchaud, C., Keogh, S. C., Stillman, M., Awusabo-Asare, K., Motta, A., Sidze, E., & Monzón, A. S. (2019). Towards comprehensive sexuality education: A comparative analysis of the policy environment surrounding school-based sexuality education in Ghana, Peru, Kenya and Guatemala. *Sex Education*, *19*(3), 277-296.

Parker, R., & Thomsen, B. S. (2019). Learning through play at school: A study of playful integrated pedagogies that foster children's holistic skills development in the primary school classroom.

Penuel, W. R., Fishman, B. J., Yamaguchi, R., & Gallagher, L. P. (2007). What makes professional development effective? Strategies that foster curriculum implementation. *American Educational Research Journal*, *44*(4), 921-958.

Persaud, D. (2019). *Empowering a Generation: Integrating Community-Based Arts Pedagogy in Los Angeles Public Schools*. California: University of, Los Angeles.

Peyser, A., Gerard, F. M., & Roegiers, X. (2006). Implementing a Pedagogy of Integration: Some Thoughts Based on a Textbook Elaboration Experience in Vietnam. *Planning and changing*, *37*, 37-55.

Pobiner, B. (2016). Accepting, understanding, teaching, and learning (human) evolution: Obstacles and opportunities. *American Journal of Physical Anthropology*, *159*, 232-274.

Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, *29*(1), 4-15.

Redes, A. (2016). Collaborative learning and teaching in practice. *Educația Plus*, *16*(2), 334-345.

Rozas, L. W., & Klein, W. C. (2010). The value and purpose of the traditional qualitative literature review. *Journal of Evidence-based Social Work*, *7*(5), 387-399.

Saenz, V. B., Hatch, D., Bukoski, B. E., Kim, S., Lee, K. H., & Valdez, P. (2011). Community college student engagement patterns: A typology revealed through exploratory cluster analysis. *Community College Review*, *39*(3), 235-267.

Sari, U., Duygu, E., Sen, Ö. F., & Kirindi, T. (2020). The Effects of STEM Education on Scientific Process Skills and STEM Awareness in Simulation Based Inquiry Learning Environment. *Journal of Turkish Science Education*, *17*(3), 387-405.

Senler, B. (2016). Pre-service science teachers‘ self-efficacy: The role of attitude, anxiety and locus of control. *Australian Journal of Education*, *60*(1), 26-41.

Shuilleabhain, A. N. (2016). Developing mathematics teachers‘ pedagogical content knowledge in lesson study: Case study findings. *International Journal for Lesson and Learning Studies*.

Slovenko, K., & Thompson, N. (2016). Social pedagogy, informal education and ethical youth work practice. *Ethics and Social Welfare, 10*(1), 19-34.

Solvie, P., & Kloek, M. (2007). Using technology tools to engage students with multiple learning styles in a constructivist learning environment. *Contemporary Issues in Technology and Teacher Education*, *7*(2), 7-27.

Southerland, S. A., Granger, E. M., Hughes, R., Enderle, P., Ke, F., Roseler, K., ... & Tekkumru-Kisa, M. (2016). Essential aspects of science teacher professional development: Making research participation instructionally effective. *AERA open*, *2*(4), 23-32.

Ssegantebuka, J. (2017). The relevance of the visual arts curriculum in the preparation of pre-service visual arts teachers in Uganda. *Problems of Education in the 21st Century*, *75*(4), 394-409.

Ssegantebuka, J., Sserunjogi, P., Edopu, R., Tebenkana, T., & Kanuge, J. B. (2021). In-Service Teachers' Perceptions of The Effectiveness of Their Pre-Service Art Education Program in Uganda. *Problems of Education in the 21st Century, 79* (1), 118.

Stevenson, H. (2019). professional learning–What is the point? Professional development in education, 45(1), 1-2.

Stobaugh, R. R., & Tassell, J. L. (2011). Analyzing the degree of technology use occurring in pre-service teacher education. *Educational Assessment, Evaluation and Accountability, 23*(2), 143-157.

Subban, P., & Round, P. (2015). Differentiated instruction at work: reinforcing the art of classroom observation through the creation of a checklist for beginning and pre-service teachers. *Australian Journal of Teacher Education*, *40*(5), 117-131.

Supovitz, J. A., & Turner, H. M. (2000). The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *37*(9), 963-980.

Tankersley, D. (2010). The ISSA Pedagogical Standards: a tool to influence quality in early childhood programs.

Tarling, I., & Ng'ambi, D. (2016). Teachers pedagogical change framework: a diagnostic tool for changing teachers‘ uses of emerging technologies. *British Journal of Educational Technology*, *47*(3), 554-572.

Tishkovskaya, S., & Lancaster, G. A. (2012). Statistical education in the 21st century: A review of challenges, teaching innovations and strategies for reform. *Journal of Statistics Education*, *20*(2).

T-TEL (2017*). Midline survey*. T-TEL: Accra.

Underwood, J. B., & Mensah, F. M. (2018). An investigation of science teacher educators‘ perceptions of culturally relevant pedagogy. *Journal of Science Teacher Education*, *29*(1), 46-64.

US Department of Education. (2004). National Survey of Postsecondary Faculty. National Centre for Education Statistics (NCES) Report 2002-151 and 2001-01.

Van Driel, J. H., Meirink, J. A., van Veen, K., & Zwart, R. C. (2012). Current trends and missing links in studies on teacher professional development in science education: a review of design features and quality of research. *Studies in Science Education, 48*(2), 129-160.

Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, *24*(1), 80-91.

Waitoller, F. R., & Artiles, A. J. (2013). A decade of professional development research for inclusive education: A critical review and notes for a research program. *Review of Educational Research*, *83*(3), 319-356.

Walker, S. L., & Fraser, B. J. (2005). Development and validation of an instrument for assessing distance education learning environments in higher education: The Distance Education Learning Environments Survey (DELES). *Learning environments research*, *8*(3), 289-308.

Wang, Y., & Liu, Q. (2020). Effects of online teaching presence on students' interactions and collaborative knowledge construction. *Journal of Computer Assisted Learning*, *36*(3), 370-382.

Westbrook, A., Kester, D., & Braver, T. S. (2013). What is the subjective cost of cognitive effort? Load, trait, and aging effects revealed by economic preference. PloS one, 8(7), e68210.

Westbrook, J. (2013). Pedagogy, curriculum, teaching practices and teacher education in developing countries.

Whitworth, B. A., Maeng, J. L., & Bell, R. L. (2013). Teacher's Toolkit: Differentiating Inquiry. *Science Scope*, *3*, 37-38.

Wortmann, K. (2020). Drawing distinctions: What is post-critical pedagogy. *On Education. Journal for Research and Debate*, *3*(9).

Yap, W. L., Neo, M., & Neo, T. K. (2016). Learner-Centred Teaching Contributes in Promising Results in Improving Learner Understanding and Motivation: A Case Study at Malaysia Tertiary Education. *Electronic Journal of e-Learning*, *14*(4), 266-281.

Zacharia, Z. (2003). Beliefs, attitudes, and intentions of science teachers regarding the educational use of computer simulations and inquiry-based experiments in physics. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *40*(8), 792-823.

Zhang, X., Gossett, C., Simpson, J., & Davis, R. (2019). Advising students for success in higher education: An all-out effort. *Journal of College Student Retention: Research, Theory & Practice, 21*(1), 53-77.

APPENDICES

APPENDIX A

QUESTIONNAIRE FOR TUTORS

INTRODUCTION

Dear tutor,

This questionnaire is designed to seek your views about tutor's knowledge and use of pedagogies in the new B Ed Curriculum for Colleges of Education. It is part of an M.Phil. thesis work being undertaken at the University of Education, Winneba. It is for academic purpose only, your support in providing an exact information is kindly requested by completing the attached questionnaire. There is no wrong or right answer. Your opinions expressed by the options provided is important. Please be guaranteed that the information that you provide in this survey will be treated confidentially and your responses will not in any way affect your status. Thank you.

SECTION A: BIOGRAPHIC DATA

1. Sex: Male [ ] Female [ ]

2. Years of teaching experience at the College

1-5 years [ ] 6- 10 years[ ] 11-15 years[ ] 16-20years[ ] 21 years and above [ ]

3. Highest Educational qualification

PhD [ ] MPhil [ ] MSc [ ] M.Ed.(Science)[ ] BSc [ ]

4. Other qualifications (specify) …….

5. (i) Number of workshops on the B.Ed. programme attended……...

(ii) Number of PD Sessions attended within two years…….

SECTION B: TUTORS USE OF PEDAGOGIES IN THE NEW B Ed CURRICULUM DURING TEACHING PRACTICES

Indicate the extent to which you use pedagogies in the new B Ed curriculum in your teaching considering the under-listed activities. Use the key provided: 0 = not at all 1= to a small extent 2 = to a moderate extent 3= to a great extent

	0	1	2	3
Activities				
Discuss course manual with preservice teachers				
Use of starter/ energizer to begin lessons				
Use of science related Games				
Use of Storytelling				
Use of Songs and rhymes				
Use of Roleplay				
Use of Modelling				
Use of low/no cost TLMs				
Use of gender responsive strategies				
Use of appropriate sitting arrangement				
Create learner friendly environment				
Use of groupwork				
Identifying which standards will be address by your lesson				
Practising inclusivity				
Aligning performance indicators, teaching and assessment				
Identify possible misconceptions of your lesson that pre-service teachers may bring to class				
Use of motivational techniques				
Use of reflective practices				

Managing the learning environment				
Use of concept maps and cartoons				
Use of PowerPoint presentations				
Use of fieldtrips to identify important scientific scenes				
Use of pyramid discussions				
Use of multimedia				
Use of computer presentations				
Use of videos				
Use of simulations				
Guide preservice teachers to develop portfolio				
Use of e-learning opportunities				
Use talk for learning approaches				
Use of inquiry learning				
Use of seminars				
Use of think pair share and square teaching and learning strategies				
Assessment Practices				
Assessing students based on the National Teachers Standard				
Use of self and peer assessment strategy to assess preservice teachers				
Use of assessment strategies such as models presentation by preservice teachers				
Use of assignments to assess preservice teachers				
Use of professional portfolios to assess preservice teachers				

SECTION C: TUTORS KNOWLEDGE OF PEDAGOGIES IN THE NEW B Ed CURRICULUM

This unit of the questionnaire seeks to get information from you about your knowledge of pedagogies in the new B Ed curriculum for Colleges of Education in Ghana. Your response would be used solely for the purpose of the study. Write your response on the dotted lines provided for all items, except item 3 where you are required to tick the option applicable. Thank you.

1. How do you feel about your background (previous knowledge) in the recommended pedagogies in the new B Ed curriculum?
   ……
2. How do you create a positive learning environment?
   ……
3. How would you rate your knowledge level about pedagogies in the new B Ed curriculum for Colleges of Education in Ghana?
   Excellent ( ) Very Good ( ) Good ( ) Fair ( ) No skill at all ( )
4. During lessons, what types of interactions do you like to encourage?
   ……
5. What is your understanding of the features of Supported Teaching in School (STS)?
   ……
   ……
6. In conclusion, suggest two (2) ways by which tutors knowledge of pedagogies in the new B Ed curriculum can be effective especially in teaching and learning?
   a. ……
   b. ……
7. After a lab experiment that involved magnetism, a preservice teacher writes that all metals are attracted to a magnet. Identify this preservice teacher's misconception and describe an appropriate strategy to counteract this misconception.

   ……
8. A tutor started a lesson by saying ―in our red blood cells, a protein called hemoglobin reacts with oxygen." Preservice teachers wonder about the lesson after this daily life example. In your opinion, kindly indicate the strategies to be employed by the tutor to facilitate easier understanding of the concept
   ……
   ……
9. Tutor takes her Early Grade science preservice teachers to the laboratory for a ―hands-on" experience with change of states of matter. A fizzy-drink can was taken out of the fridge, and after a few seconds, the can started to ―sweat". The tutor asks preservice teachers to describe the mechanism leading to the sweating of the can.

i) Suggest suitable pedagogies that can be used in this scenario;

……

ii) Which assessment modes should the tutor use to better assess preservice teachers understanding of the concepts?

……

APPENDIX B

SAMPLE – TUTOR INTERVIEW

Interview with Science Tutors

Pre-discussion tasks:

1. Welcome participant

2. Assure confidentiality

3. Confirm consent for participation and tape recording or take note (confirm that they have signed the consent form)

4. Establish permissive environment (no wrong answers)

Introduction:

Thank you for taking part in this research and for agreeing to be interviewed. I am a student who is on an MPhil programme at University of Education, Winneba. This interview will not last more than an hour. The aim of the interview is to;

1. Seek your knowledge of pedagogies in the new B. Ed curriculum which CoEs are currently implementing.

2. Examine the extent to which you use pedagogies in the new B. Ed curriculum

3. Explore factors that affect science tutors' use of the pedagogies in the new B. Ed Curriculum.

Please remember there are no correct or incorrect responses; so please feel free to speak your mind and be as honest as possible. I hope that your opinions and reflections will help in obtaining data for this study. Just to confirm, all information that we collect during this discussion will be confidential. If we quote anything you say in a report, your name, position or college will **not** be used – you will only be identified as _a science tutor'.

This interview will be recorded and transcribed; but all of the information will be kept in a secure place and only the researcher will be able to access it.

1. Kindly share with me how you manage your classroom.
2. You have been involved in continuous professional development for the past four years, could you share your experience with me regarding the recommended pedagogies in the new B Ed curriculum?
3. What pedagogies have you used recently in your teaching?
4. How does the structure of the pedagogies in the new B. Ed curriculum align with modern and effective models to teaching?

5. While teaching, how do you decide what pedagogy to use?
6. Is the duration of lessons adequate in ensuring that you use pedagogies in the new B Ed curriculum well?
7. Kindly share your understanding of principles guiding learning outcomes with me.
8. What do you think are some of the barriers that impede the effective use of pedagogies espoused in the new B. Ed curriculum?
9. How do these challenges impact on the use of the pedagogies in classroom teaching?
10. What kind of support do you need, to use the pedagogies in your lessons and how readily is it obtainable?

APPENDIX C

OBSERVTION CHECKLIST

The aim of this lesson observation checklist is to identify if science tutors use pedagogies recommended pedagogies in the new B Ed curriculum for colleges of education during their teaching.

Put a tick in the appropriate column (Yes/No) on the observation you make during the lesson.

SN	ITEM	YES	NO
1	Tutor begins lesson with starter/energizer		
2	Tutor identifies possible misconceptions of the lesson that pre-service teachers may bring to class		
3	Tutor uses multimedia in teaching		
4	Tutor uses simulations in teaching		
5	Tutor uses videos in teaching		
6	Tutor uses computer presentations		
7	Tutor uses science related games.		
8	Tutor uses rhymes and songs		
9	Tutor uses concept maps		
10	Tutor uses concept cartoons		
11	Tutor uses laboratory activities		
12	Tutor uses modelling		
13	Tutor uses storytelling		
14	Tutor uses groupwork		
15	Tutor uses PowerPoint presentations		
16	Tutor uses seminar		
17	Tutor uses inclusion		
18	Tutor uses gender responsive pedagogy		

19	Tutor uses reflective practices		
20	Tutor guides preservice teachers to present models for assessment		
21	Tutor uses assignments to assess preservice teachers		
22	Tutor uses quizzes to assess preservice teachers		
23	Tutor uses tests to assess preservice teachers		
24	Tutor assesses preservice teachers based on the National Teachers Standard		
25	Tutor guides preservice teachers to develop portfolio		

APPENDIX D

RELIABILITY RESULTS

Reliability Statistics for the Section C (Closed-ended Items) of the Questionnaire

Cronbach's Alpha	No. of Items
0.837	37

APPENDIX E

CONSENT FORM

Consent form for science tutors who will be interviewed on the research topic: *Assessing Science tutors' knowledge and use of recommended pedagogies in the new B.Ed. curriculum: the case of science colleges of education in the Northern Region of Ghana*.

I am a student at the Department of Science Education, University of Education, Winneba. I am conducting a study on science tutors' knowledge and use of recommended pedagogies in the new B.Ed. curriculum at science colleges of education in the Northern Region of Ghana. If you decide to be part of this study, I will interview you about science tutors' knowledge and use of recommended pedagogies in the new B.Ed. curriculum ideas. The interview may take about 30- 45 minutes and will be tape recorded. You may request the recording to be stopped temporarily or permanently if at any time you feel uncomfortable. I will conduct and transcribe the interview. You will be given with a copy of the interview transcript for review and approval. Your participation is voluntary and you have the right to withdraw from the project at any time. If you choose to withdraw, I will remove any of the information relating to you from the project, including any final publication, so long as it remains practicable to do. The research will not interfere with the normal teaching schedule. All information gathered will be treated with strict confidence and your confidentiality and anonymity will be ensured in all publications. All data gathered will be securely kept in a locker which only I will have access to and any data that can identify you will not be given to any other researcher or agency. The results of the study may be submitted for publication to national or international journals or presented at educational conferences. You may at any time ask for

additional information or results from the study. If you would like more information or seek further clarification about the research, you can contact me (on 0242288207 or e-mail: wasilaabukari5@gmail.com) or my supervisor Dr Ernest Ggman-wara (on 0244150836). The only anticipated risk associated with this project is the time you have to commit for the interview. If you are interested in being part of the interview, please sign the consent form attached to this information sheet. Thank you for your decision to be part of this research project.