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EVALUATING TEACHERS' PROFESSIONAL DEVELOPMENT FOR ICT USE: TOWARDS INNOVATIVE CLASSROOM PRACTICES

Dr. Douglas Darko Agyei

Department of Science and Mathematics Education
University of Cape Coast, Cape Coast, Ghana

ABSTRACT: *This paper describes an evaluation study designed to investigate the impact of an ICT-Instructional digital innovation in teaching Mathematics, English and Integrated Science subjects from the teacher capacity building professional development programme to classroom implementation at senior high school levels in Ghana. Interviews and survey data were used for data collection following a week professional development programme on the instructional digital learning training. The study demonstrated that the teachers increased in ICT proficiencies but this was limited to their own professional development and not so much of classroom implementation of ICT which results when transfer of learning takes place from training to practice. The study reported that teachers faced a complex mix of factors that when combined, contributed to challenges in transferring the ideas gained in the training programme to the classroom situation. It was evident from the findings that more systematic efforts are needed at the school levels and at the level of stakeholders who implement in-service teachers' professional development programmes to move the goal of transforming teaching and learning through ICT-based innovations. Based on the outcomes, the study discussed recommendations to help smoothen the transition from teacher professional development programmes to actual classroom implementations in Ghanaian senior high schools and such similar contexts.*

KEYWORDS: Teacher, Developmenr ICT, Classroom, Digital Innovation, Mathematics, English, Integrated Science, Ghana

INTRODUCTION

Integration of Information and Communication Technology (ICT) is high on the education reform agenda worldwide particularly in developed countries. Often ICT is seen as an indispensable tool to fully participate in the knowledge society (Peeraer & Van Petegem, 2011). ICT's are therefore perceived to provide a window of opportunity for educational institutions to harness and use technology to complement and support the teaching and learning process. Although a large body of research on factors determining the integration of ICT in education emerge from developed countries, recent development indicate that developing countries are finding means to participate effectively in the global information society and to address challenges regarding ICT in education (Tilya, 2008). The emerging developing countries do not only draw on this research but are also gradually advocating for ICT use for teaching and learning to gain acceptance in education.

Ghana is an interesting case for research on integration of ICT. Ghana's efforts to use ICT in education began to receive governments' attention only recently. The integration of ICT into her educational system was formally introduced as part of educational reforms which began in

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September 2007 as part of government's initiative to improve quality of teaching and learning in the nation's schools. One major requirement of the 2007 educational reform was to ensure that all students in pre-tertiary institutions in Ghana acquire basic ICT literacy skills (including internet use) and apply these not only in their studies but also in a variety of ways in their everyday life activities (CRDD,2007a, b and c). As a result, the government and other institutions in the past have invested huge sums of money in procurement of computers and establishment of computer labs in most SHS's. Although these efforts have not yielded the needed results in extending instructional methods or promoting integration of technology in the schools' curriculum, the Government has not shelved her efforts in improving the quality of education by transforming teaching and learning through ICTs.

For instance, the Government of Ghana through Ministry of Education (MOE) and Ghana Education Service (GES) in recent times has initiated a project with the view to promote integration of ICT in Mathematics, English and Integrated Science (MEIS) curriculum in Senior High Schools (SHSs) in Ghana. This project aimed at providing internet access for all SHSs with a view to supporting teaching and learning achievement. As part of the activities of the project, installation of connectivity in 400 SHSs as well as development of an implementation manual for pedagogical integration of ICT were done. Essential to this project, unlike similar earlier projects, was a professional development programme aimed at equipping the MEIS teachers in those SHSs to teach their subject matter with ICT. The professional development training programme was meant to develop teachers' capacity to integrate ICT to enhance their current teaching practices in teaching MEIS subjects across the beneficiary schools of the project.

Several months after this intervention, teachers who participated in the programme have been teaching in their various SHSs.. What remains to be done is a follow-up to see if the training programme has yielded the desired results in the way the teachers teach their subject matter after the training. Fishman and Krajcik (2003) reported that in the space between originating context and broader applications or continuity, most innovations either disappear or become unrecognizable and as Fullan (2007) reported, a great majority of policies and innovations did not get implemented even when implementation was desired.

This study is an independent one to explore whether the professional development imparted on the teachers' knowledge and skill and to ascertain the extent to which the knowledge gained reflect in the teachers' current teaching practices.

Conditions for Implementing Educational innovations

According to Fullan (2007), implementation consists of the process of putting into practice an idea, programme or set of activities or structures, new to the people attempting or expected to change. Burkman (1987) notes that in many cases, the failure of an innovation is not due to the quality of the product, but results from those responsible for its successful implementation failing to consider variables other than the product itself; These arguments suggest that implementation is key for educational projects or innovation to have lasting impact on education.

A number of studies have shown that though most research projects yielded valuable knowledge about nature of cognition, teaching and learning; yet they failed to have a broad or lasting impact on education. These studies point out that learning from a formal training programme is often not

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or in a limited way applied on the job (e.g.Saks, 2002; Yamnill & McLean, 2001). Questions raised normally centre around the degree to which trainees effectively implement the knowledge, skills and attitudes gained in a training context to their classroom practices. Several factors required for the successful implementation of educational project (Dede & Nelson, 2005; Fullan, 2007) have been identified by different researchers to account for this.

Dede and Honan (2005) identified four key themes in adapting an educational innovation successfully in some local setting to effective usage in wide range of contexts: 1.*Coping with change:* context, leadership, and funding, 2. *Promoting ownership:* building constituent support; institutionalizing innovations, 3. *Building human capacity:* working with collaborators and partners; providing Professional development and 4. *Effective decision making:* interpreting data; creating and applying usable knowledge. Fullan (2007) identifies at least three components or dimensions at stake in implementing an innovation in a classroom: (1) the possible use of new or revised materials (Instructional resources such as curriculum materials or technologies, (2) the possible use of new approaches (i.e. new teaching strategies or activities) and (3) the possible alteration of beliefs (e.g. pedagogical assumptions and theories underlying particular new policies or programs. According to him, all three aspects of change are necessary because together they represent the means of achieving a particular educational goal or set of goals.

These arguments regarding factors influencing successful implementation of educational innovations seem not to differ from innovations that are technologically inclined. For example, Fishman and Krajcik (2005) argued that anyone who is working to create a lasting change with technology that have sustainable impact on teaching and learning must be mindful of creating innovations that function as part of systemic reforms. According to him, a fundamental goal of systemic reform is alignment across component of school systems (such as administration and management, curriculum and instruction, assessment and policy, and technology). According to Webb and Cox (2004), one of the reasons for the unenthusiastic response to ICT innovation amongst teachers might be that technological knowledge or skill is either absent or lacking in the processes that underpins teachers' planning.

The literature reviewed here served as a benchmark to explore potential factors for the successful implementation of an ICT innovation among teachers in Ghana. Prior to this study, a select cohort of teachers were previously involved in an Instructional digital learning training programme and development to acquire the skills and knowledge in teaching Mathematics, Science and English with ICT and Internet resources in SHSs. This study explored the results achieved after the programme: the quality and the extent of implementation of the professional development ideas by the teachers in their current teaching practices.

The Professional Development Programme (PDP)

The Professional development programme was organized to target Science, Maths and English teachers from 400 SHSs that participated in the study. Preceding the professional development programme, training of master trainers' programme was organised. The focus of the training of the master trainers was to build their capacity to train other teachers during the professional development programme. The training was conducted with the goal of familiarising the master trainers with the content of training modules to be used for training teachers during the professional

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development programme, the facilitation approach, as well as the relevance and appropriateness of the training materials for the intended audience. Three modules aimed at enhancing teacher ICT competencies were developed and used for the training purposes.

Module 0 focused on revision of ICT Basic Skills through problem solving and group work strategies. **Module 1** focused on Applying ICT in Mathematics, English and Integrated Science teaching. **Module 2** focused on Infusing ICT in Mathematics, English and Integrated Science teaching. Emphasis was on exploring how ICT can be used to support didactic and problem-based teaching & learning and how teachers can shift towards technology infusion in their MEIS classroom practice. The modules and other useful resources were placed on a designated portal or website where teachers participating in the programme could access. The national master trainer team was organized into seven training teams to provide training for seven teacher groups. Training focused on building a common understanding on ICT concepts and skills as well as the specific skills required for the meaningful use of ICT for teaching and learning in Mathematics, English and Integrated Science. During the training sessions, the national master trainers used the modules to guide trainees to develop the theoretical foundation/concepts as well as the practical skills they need to design and teach ICT-based lessons. The lesson design and implementation adopted Technological Pedagogical Content Knowledge (TPACK) as a conceptual framework to examine and develop the knowledge and skills teachers needed for ICT integration. Developing the teachers' TPACK was done through" Learning Technology by Design", an approach in which teachers were involved in collaborative authentic problem solving task with ICT. Trainees had the opportunity to scout for resources from the internet. Following exemplary materials in the modules, they were to design their lessons, plan and teach the lessons at micro-levels in teams or collaborations. The teaching approaches which were adopted to be used in teaching their subject matter with ICT were the Didactic Pedagogical Approach (DPA) and the Problem Based Learning (PBL) approach. The other part of the PDP encouraged teachers to upload their developed lesson on the designated portal to promote professional community collaboration with other teachers from schools within the select 400. The expectation was that the portal will be accessible to teachers even after the programme is over because provision of internet (i.e., supply of ICT logistics including servers and routers for internet connectivity) to the schools formed an integral part of the intervention programme. The training was spread over 8 weeks, each group spending a period of one week duration each.

Several months after the training, the teachers who were involved in the training still teach in their various SHSs. What remains to be done is a follow-up to see if the PDP imparted on the teachers knowledge and skills and whether they still hold and implement the programmes' ideas in their current teaching practices.

A Conceptual Framework of the study

Dede and Honan (2005) reiterates that a clear understanding of factors that support implementation of a successful innovation in a particular context is critical when evaluating an educational project. Thus, it is essential that in judging the true value and worth of any professional development endeavor, a model which is effective in evaluating elements at different levels of the professional development arrangement is used. This present study therefore sought to apply Guskey's professional development evaluation model to evaluate the efficiency, effectiveness and relevance

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of a professional development programme for ICT use in teaching among MEIS Ghanaian teachers who took part in the study as mentioned earlier on. Thomas Guskey has been writing for some time about the importance of seeking evidence of effectiveness in professional development programmes (see Guskey 1985; Guskey 1986; Guskey 1990; Guskey 1991; Guskey and Sparks 1996; Guskey 1998). While Guskey's focus has been on professional development for teachers and schools, his research on accountability and evaluation also have application beyond the school environment. According to Guskey (2000), effective professional development evaluations require the collection and analysis of the five critical levels of information. Thus, the model's key elements are:

- **Level 1:** Participants' Reactions – *Participant's initial satisfaction with the experience;*
- **Level 2:** Participants' Learning – *New knowledge and skills of participants;*
- **Level 3:** Organization support and change – *The organization's advocacy, support, accommodation, facilitation, and recognition*;
- **Level 4:** Participants' Use of New Knowledge and Skills – *Degree of quality of implementation and;*
- **Level 5:** Student Learning Outcomes – *Student learning including Cognitive (performance & achievement), Affective (attitude & dispositions) and Psychomotor (skills and behavior).*

Guskey indicated that with each succeeding level, the process of gathering evaluation information gets a bit more complex. He reiterated that each level builds on those that come before, success at one level is usually necessary for success at higher levels.

The Guskey (2000) Model was used particularly in the design of this study and for the evaluation processes of the PDP. As indicated, this evaluation study is a follow-up on a cohort of MEIS teachers who took part in a professional development arrangement to foster adoption of technological innovation in their teaching practices in their various SHSs.

The study focused on only the first 4 levels of Guskey's Model. *Level 1*: Participants' Reactions, focused on the teachers' general impressions about the Instructional digital learning training programme and its components (e.g., activities, time and effort, usefulness of resource materials, effectiveness of resource persons) in enhancing teaching and learning of MEIS subjects; *Level 2*: Participants' Learning, focused on the quality of learning during the training (e.g., are there change in teachers' attitudes, competencies, self belief of ICT use in teaching); *Level 3*: Organization support and change, focused on schools' conditions and practices that undermine or support teachers' implementations efforts and recognition of ICT use by the MEIS teachers after the training programme ; *Level 4*: Participants' Use of New Knowledge and Skills, focused on the use of the training programmes' ideas in practice. At this level, the emphasis was on whether teachers were applying the knowledge and skills they had acquired during the training in their professional and teaching practices, what conditions either promoted or hindered implementation of the programmes' ideas in their schools. *Level 5*: Students' Learning Outcomes was not assessed in this study. Firstly, for such a PDP endeavor, it was difficult to gather evidence of student learning

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outcomes within the period of time the study was conducted. The kind of information needed at this level requires a longer time to assess. Secondly, to show that a professional development programme uniquely leads to improvements in student learning can be complicated. It requires a level of experimental rigor that is hard and impossible to attain in this study.

Research questions and Research Design

This study which aimed at implementing an Instructional digital innovation programme among MEIS subject teachers in SHSs in Ghana were guided by two research questions: (1) how did the MEIS teachers perceive the contribution of the PDP to developing their experiences (teachers' learning and teaching) of technology-enhanced lesson; and (2) to what extent did the PDP promote ownership, transfer of learning and practicability among the MEIS teachers? In the study: *Ownership* referred to the schools' claiming responsibility, for actions regarding supporting the instructional digital innovation use in teaching and learning; *Transfer of learning* , referred to whether new knowledge, skills and attitudes acquired by teachers during the training programme were being applied or used in their professional and teaching practices; and *Practicability*, referred to how new knowledge, and skills acquired after the training are being used to support use of the innovation by teachers in the classroom situations.

The study employed an Embedded mixed method research design (Creswell, Plano Clark, Gutmann & Hanson, 2003); including the collection of quantitative and qualitative data.

METHOD

Participants

The main study participants for the Evaluation study were 400 teachers of Mathematics, English and Science who took part in the professional development programme from a selected 400 SHSs in Ghana. An online survey targeted all these teachers who participated in the training programme across all the ten regions in Ghana. Hundred and ten (110) teachers representing about 28% responded to the survey. Of the total respondents, 88 representing 78.6% were males whiles 22 representing 19.6% were females. The distribution of the professional qualification of the respondents occurred as follows: First degree (79%); Masters Degree (15.2%) and Diploma (5.7%). While the majority (32%) of teachers had 16-20 years working experience, a large proportion were new teachers with working experience of 5 or less years. Only a small percentage had 20 or more year's experience of teaching.

Research Instruments

In Table 1, an overview of the data collection procedures at the different levels of Guskey's critical level evaluation model is presented.

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Table 1: Relationship between Data Collection Procedures and the Conceptual Framework

Evaluation Level	Typical Questions Addressed	Data Collection Instrument	What will be Measured/Assessed
Participants' Reaction	Did participants like the training? Was time well spent?	Online Survey Interviews	Initial satisfaction with experience.
Participants' Learning	Did participants acquire the intended knowledge or skill?	Online Survey Interviews	New knowledge and skills of participants
Organization and Change	Did the Instructional digital learning training programme activities promote changes that were aligned with the mission of the school?	Online Survey Interviews	The schools' advocacy, support, accommodations, facilitation and recognition
Participants' Use of New Knowledege and Skills	Did participants effectively apply the new knowledge and skills?	Online Survey Interviews	Degree and quality of information

Online Survey

This study adopted an online survey evaluation tool (developed from a survey monkey) which was used previously for the data collection during the PDP for the MEIS teachers. A questionnaire was developed and uploaded in the survey monkey and used to collect data at the first 4 levels of Guskey model from the MEIS teachers who participated in the study. The focus was to systematically assess the impact of the training programme on the Instructional digital innovation in teaching MEIS subjects from the teacher capacity building professional development programme to classroom implementation levels. Items on the survey included the MEIS teachers' perceptions and how they valued the Instructional digital learning training programme and its components. The survey also contained items which measured teachers' perceptions regarding the extent to which they used ideas of the programme and factors influencing their actual use (Sample questions for each level of Guskey's model is shown in Table 1). The survey also included thirty statements representing factors promoting/hindering teachers' use (inability to make use) of the Programmes' ideas. These items were classified under 8 sub-scales drawn from Ely (1999) formulated eight conditions for the implementation of an educational innovation. The conditions have been defined as follows:

- *Sufficient knowledge and skills* – the knowledge and skills acquired during the training programme which reflect in the way MEIS teachers currently design their lessons and teaching practices with ICT.
- *Dissatisfaction with the status quo* – teachers' dissatisfaction with existing teaching approaches in MEIS subject areas
- *Commitment* – MEIS teachers' dedication to their students' learning, in particular through ICT and to their own professional developments as teachers

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- *Availability of time* – MEIS teachers' willingness to devote learning time to become skilled in design and practice of ICT-based lessons during pre-lesson preparations
- *Availability of resources* – amount of ICT resources currently available and accessible to MEIS teachers to successful transfer their learning of the Instructional digital innovation in the teaching of their subjects.
- *Participation* – MEIS teachers' involvement in decision making with regards to decisions that relate to the planning and designing of ICT innovation in the school setting
- *School Culture* – conditions (such as school resistant to change, importance of leadership in managing ICT, classroom timetabling, provision of training opportunities) for ICT practices at the school level
- *Rewards and Incentives* – existence of extrinsic or intrinsic rewards/incentives provided by school management which are presumed to motivate MEIS teachers' use of ICT in teaching

For all the sub-scales, a five-point Likert scale (1=strongly disagree, 5-strongly agree) was used. The scores were interpreted as follows: 1 is the lowest possible score, which represents a very strong negative perception, while the 5 is the highest possible score which represents a very strong positive perception.

Interviews

Interviews were conducted for 15 teachers from the SHS's that were involved in the study. Interview data was meant to provide in-depth elaborations for data collected through the questionnaire.

Data collection and data analysis procedures

The online questionnaire link was sent to all the participants through their emails they provided during the PDP training. Responses were later downloaded from the survey monkey and collated. For the Interviews, the author visited the selected schools and interviewed the selected teachers. To analyze the data descriptive statistics, t-test and ANOVA were used. Interview data were audio taped and transcribed using data reduction technique (Miles & Huberman, 1994).

RESULTS

Using the Guskey's framework for evaluating professional development programme, information was collected and analysed at four levels of the Instructional digital training programme and its implementation in the real classroom situation. The findings reported here focused on data collected via the online survey evaluation tool corroborated by interview data collected from the teachers.

Teacher Reaction to the Professional Development Training Programme

The first level of evaluation focused on the teachers' reaction to the Instructional digital learning professional development programme. The purpose was to understand what worked and what did

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not work in the processes of the PDP and to develop strategies for improving its design and facilitation for future initiatives. The teachers in the study reported their perceptions and how they valued the Instructional digital learning training programme and its components via the online survey. The results showed overall positive high perceptions (M=3.96, SD= 0.581) (ie. approximately 'agree') to all the positive statements regarding the PDP its components. Most components of the PDP: Use of exemplary materials (M=4.23, SD=0.657), Collaboration in teams (M=4.30, SD=0.735), Resourcefulness of facilitators (M=4.18, SD=0.690) and Use of PDP Modules (M=4.03, SD=0.849) were highly valued by the teachers indicating that most of the teachers were satisfied with various aspects of the training programme to develop their knowledge and skill in applying and infusing ICT in professional practice and MEIS subject teaching.

Table 2: Descriptive Statistics of Components of the Training Programme

Item	Mean	SD
Use of exemplary materials (designed lesson plans) promoted my learning of ICT-enhanced activities	4.23	.657
Collaborations in teacher subject teams enhanced my learning in the PDP process	4.30	.735
Use of facilitators/Resource person promoted my learning and design of ICT-enhanced lessons	4.18	.690
PDP Modules promoted learning and design of ICT-enhanced lessons	4.03	.849
Use of Web-Resources facilitated my learning of ICT-enhanced lesson design	3.86	1.083
Sufficient time was allotted for activities in the programme	3.23	1.201

Note: 5= strongly agree, 4=agree, 3=uncertain, 2= disagree, 1=strongly disagree

Interview data gathered with the teachers supported the findings. Participants were of the view that the professional development approach adopted 'learning technology by design' provided opportunity for the teachers to develop their attitudes, knowledge and skills in ICT integration through collaborative design and enactment of ICT-based MEIS curriculum materials. They reiterated that collaboration in design teams in which the teachers work with the peers was an important means to stimulate and support teacher learning. The approach improved interaction and interdependence among teachers, making them discover how to share knowledge and ideas of relevant information. The PDP manuals were necessary components for the teachers' learning during the training. It promoted the teachers' understanding of what integrating ICT in lessons is about, promoted pedagogical design capacity and promoting their decisions on how to proceed with their own designs. The use of exemplary materials (designed lessons) provided a theoretical and practical insight of ICT-supported learner-centred lessons and hands on experience promoting concrete how-to-do suggestions which facilitated a better implementation of the innovation. Findings also showed that the role of resource persons were mainly facilitating and that was a good approach to challenge teachers as well as sustain their focus in preparing their own lesson and enacting them in micro-teaching.

Participants also reported on aspects of the programme which did not auger well for their learning. Table 2 shows the teachers' ranking on two of such issues: "Use of Web-Resources facilitated my

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learning of ICT-enhanced lesson design*"* and "Sufficient time was allotted for activities in the programme*"* which were ranked relatively low. Interview data reiterated that the progarmmes' critical area for improvement that was mostly commented on was the quality of the internet connectivity. The teachers expressed general dissatisfaction and frustrations on the poor internet accessibility during the training programme. Lack of access to computers was also presented as a key factor that impeded teacher learning of ICT use in the training programme. As a result most participants resorted to the use of their mobile phones during the programme which did not serve the purpose any better. Another critical area for improvement presented by many of the participants was the issue of time. Although trainees were of the view that the content of the programme was relevant, they indicated that the time was limited in proportion to the package of the programme content to be covered over the period of 5 days. In particular, a number of the teachers indicated that there was little or no time to try out the designed lessons among their peers.

Professional Learning of the MEIS teachers

The second level of evaluation focused on the quality of teacher learning in the training programme process. Findings showed that teachers' perceptions about the impact of the training programme on their learning were a mixed one. Whiles some teachers indicated how much confidence they had acquired to teach their subject matter with ICT others were reluctant to indicate that they could transfer their learning from the programme in designing and teaching their own subject in their classrooms. A number of teachers had the opportunity to clarify their opinions about the learning that took place during the interviews. The following were some of the statements made by some teachers:

> The training content was very relevant to my needs and I learned a lot of things that will help me improve on my teaching as far as integrating technology is concerned…
>
> I have learnt a great deal of pedagogical based approach of teaching science and I hope to use it extensively in my future lessons…
>
> It was difficult to follow the activities to design lessons in my subject area because just as I did not have a personal laptop to follow the activities, the internet connectivity was such that one could hardly have access to the modules. So most of us sat as observers …

Figure 2 shows the distribution on teachers' responses on aspects of their learning that took place during the training programme. What was most popular which most teachers indicated were confident to do was the use of Internet Resources to support students' concepts formation teaching their subject matter (M= 3.80). The use of Problem Based Learning pedagogical approach (M= 3.59) to support student learning with the aid of computers was indicated as the second best skill and knowledge learned by the teachers.

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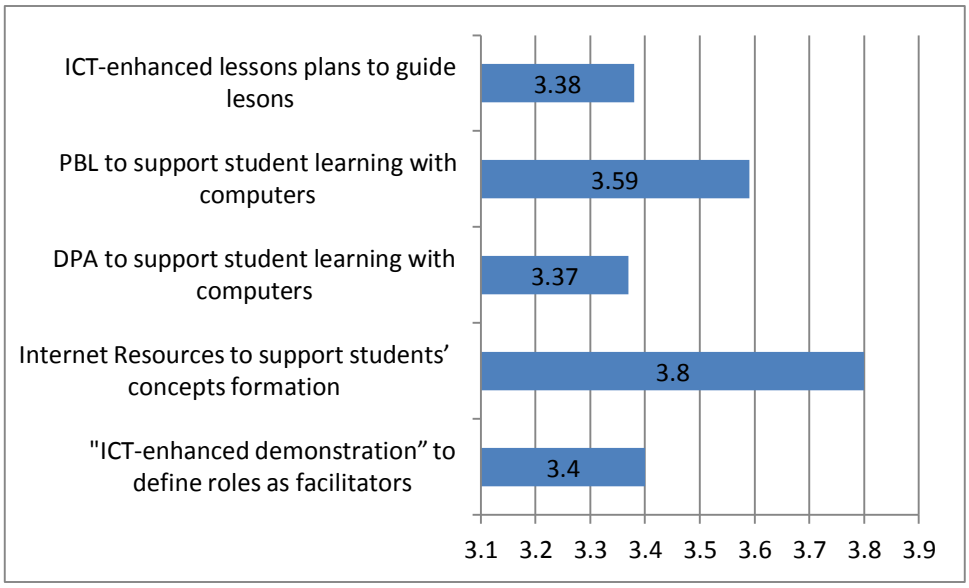

Figure 2: MEIS Teachers' Learning from the training programme

The teachers indicated responses on other skill and knowledge learnt: applying didactic pedagogical approach to support student learning with the aid of computers (M= 3.37), using ICT-enhanced lesson plans to guide lesson implementation (M= 3.38) and applying "ICT-enhanced demonstration" to define roles as facilitators in lessons (M= 3.4) although they were relatively low. A number of reasons were identified why some teachers were not able to learn the required skill and knowledge the programme intended to impart on trainees. First of all it appears the background knowledge in basic computer skills of teachers differed widely among teachers. Whiles some were novices in basic computer use, others had some computer literate skills and unfortunately the training could not ensure a common understanding on basic ICT concepts through its activities. As a result of the different entry levels, participants' learning which focused on applying basic ICT in Mathematics, English and Integrated Science teaching were done at different levels. While participants were expected to bring laptops from their schools to the programme many arrived without laptops. Thus, majority of the teachers who were not fluent in the use of computers and indeed came to the training without their own computers had complex challenges and frustrations learning barely anything at the training as hordes of trainees had to crowd around one computer amidst other difficulties like internet access, poor visual and audio quality in the equipments used and continuous breakdown of internet services.

MEIS Teachers' Use of New Knowledge and Skills

A major question dealt with in the study was whether the MEIS teachers were able to transfer their knowledge and skill gained in the Instructional digital learning training programme in the way they design and teach their lessons in MEIS currently.

It was reported that less than 50% (Agree= 35% and Strongly Agree = 11%) of the MEIS teachers who received training implemented aspects of the ideas from the training programme. A large number (39%) of them were still uncertain and perhaps had not understood the reasons for the training programme or might have been hindered by certain prevailing conditions in their school

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setting. For example some teachers reiterated in the interviews that they were not well informed that the ultimate goal of the training was to improve their classroom teaching with ICT to enhance their students' learning of MEIS subjects in the various schools. Another flaw as were reported by the teachers was the degree of involvement of their heads of the institutions during and before the training programme. It appears that although most heads had taken delivery of some ICT logistics supplied to the schools, it was not made clear to them what the focus of the training of the teachers was about and what their roles as heads were. As a result most of them did not play any supervisory role to ensure that teachers who took part in the training made use of their knowledge acquired in their teaching.

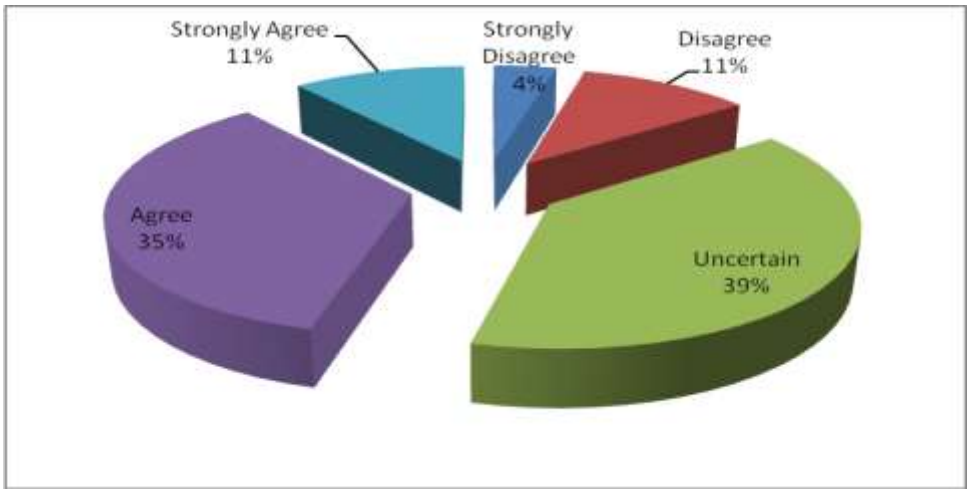

Figure3: MEIS Teachers' Reported Use of Training Programme Ideas

Teachers who implemented (M = 3.38, SD= 0.961) aspects of the training progarmme were reported to be low in general. Table 3 shows levels of classroom implementations of components of the PDP. The results did not differ significantly by experiences of teachers nor by gender. What seemed to be most popular (although not encouraging) was the MEIS teachers' use of internet resources to promote students' active learning (M=3.74, SD=1.223). The teachers indicated that they hardly consulted or accessed resources from the project website (M= 2.97, SD= 1.27). It did not seem to them that resources and lessons plans developed during the training were loaded to the designated portal to provide universal access to all the teachers. Most teachers did not seem to be aware of the purpose of the projects' portal and it was not clear whose responsibility it was to upload useful e-content to the portal to promote professional community collaboration among them.

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Table 3: Classroom Implementation of the ICT-based Trainings' Ideas

Item	Mean	SD
I implement student learning activities for my lessons to promote active learning with the aid of internet resources	3.74	1.223
I implement student self-regulated learning for my lessons with the aid of computers	3.07	1.278
I use the exemplary lessons designed during the training programme for some of my lessons	3.51	0.906
I consult the project's website to access useful resources to aid my teaching	2.98	1.272

Note: 5= always, 4=often, 3= sometimes, 2= seldom, 1=never

The overall results suggest that ICT-based implementation at the school level is feasible and could impart teachers teaching approaches. It is also evident that lack of effective communication between project implementation agents and schools was a possible factor affecting implementation of the Instructional digital training programme.

Conditions influencing MEIS teachers' use of the Instructional digital Innovation

As reported earlier in Table 3, the implementation of *the Instructional digital innovation* (M = 3.38, SD= 0.961) in the classroom was woefully low. Analysis of results from the questionnaire responses indicate that the teachers' perceived factors that influence/hinder the implementation of the innovation in teaching MEIS in their classrooms differ. In Figure 4, the factors which influence teachers' actual use of the innovation in class are shown.

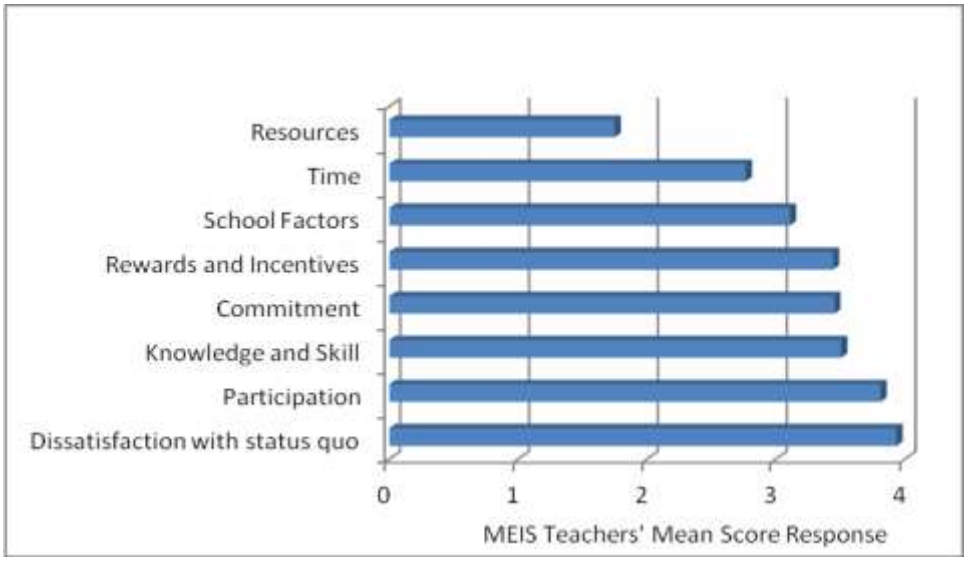

Figure 4: Conditions influencing implementation of the ICT innovation

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An ANOVA test indicated that the teachers did not differ significantly in their response by their working experiences .Overall, teachers' dissatisfaction with status quo (M=3.94, SD=.734) was the most valued factor reported; indicating that teachers expressed their dissatisfaction with the existing methods of instruction and reiterated the need to change the existing teaching approaches. This was followed by teachers' participation (M=3.94, SD=.734). The MEIS teachers tended to agree (M=3.81, SD= 1.094) that they had opportunities to communicate their ideas and opinions with regards to decisions that relate to the planning and teaching with ICT resources in their school setting. Knowledge and skills (M=3.51, SD= .898) appeared moderate; indicating the teachers had acquired some knowledge and skilled' during the preparatory programme and was an influential factor for using ICT in their classroom teaching. Thus, it is encouraging to note that in spite of the limitations of the training programme reported by the teachers' most of them had acquired sufficient knowledge and skill which indicates how well the training programme contributed to their professional learning. School related factors such as *availability of ICT resource* and *time* were weak in promoting the teachers' use of the innovation. The teachers expressed their frustrations regarding these observations in various ways. The following were some of the statements made by some teachers:

> My school did not receive any server so we do not have any connectivity. Apart from the problem with ICT resources, there are also problems with timetabling. The period of teaching mathematics with ICT is very short whereas the workload is huge…
>
> The leadership of the school does not place so much priority to ICT use in teaching. As far as leadership goes in the school, use of ICT is not a large focus so there is little I can do…

Problems with inaccessibility of ICT in the schools had to do more with sustainability of connectivity. According to some teachers there were frequent cut offs of Internet connectivity by the suppliers due to delays or failure of schools to pay for connectivity fee especially after the first month of the connectivity. At the school level, it appears that communication regarding who (whether the project managers or the schools) was to pay for connectivity supplied by service providers was not made clear and this created a lot of confusion. Unfavorable School conditions such as classroom timetabling, school resistant to change and importance of leadership in managing ICT were also perceived as hindrances to teachers' implementation of ICT use in their classrooms. For instance, it was surprising to find that servers and other ICT facilities supplied by the project were sitting in the storehouses of some schools unknown to the heads and or ICT coordinators in some cases. Most teachers also kept to their former ways of teaching for reasons best described by the author as lack of support in the face of a wide range of responsibilities. The teachers indicated that they had challenges balancing the demands of a crowded curriculum with providing students with opportunities to explore concepts using ICT in ways that embrace the principles of lifelong learning. The findings of the study therefore suggest that teachers faced a complex mix of factors that when combined, contributed to challenges in transferring the ideas gained in the training programme to the classroom situation.

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DISCUSSION

Prior to this study, a select cohort of teachers were previously involved in an Instructional digital learning training programme and development to acquire the skills and knowledge in teaching Mathematics, Science and English with ICT and Internet resources in SHSs.This study explored the impact of the training programme on the Instructional digital innovation in teaching MEIS subjects from the teacher capacity building professional development programme to classroom implementation levels. The study has demonstrated that the teachers increased in ICT proficiencies but this was limited to their own professional development and not so much of classroom implementation of ICT which results when transfer of learning takes place from training to practice. Participants of the study expressed general satisfaction with PDP content and processes. For example the approach of teacher learning, collaborative design in design teams in which groups of participants developed and modeled their own lessons after exemplary materials and taught their peers in some cases was a viable and effective one for learning about technology integration (cf. Koehler & Mishra, 2005).

While the programme content and processes were well received, essential conditions to support the programme were seemingly not adequate. Inadequate ICT equipment for participants training was a big hurdle. Most training centres were not equipped for the training programmes and so lacked the necessary facilities; this inordinately complicated the training as hordes of trainees had to crowd around one computer amidst other difficulties like internet access during the training in some centres. Evidence from the study also showed that the training programme did not offer adequate opportunities for the teachers' to develop pedagogical integration of ICT experiences (cf. Webb & Cox, 2004). It appears a lot of activities were packed into the training programme against the constraints of time and other resources.

Undoubtedly, ownership, transfer and practicability of the new knowledge and skills acquired after the training were complex constraints faced in the study. The study hardly demonstrated ownership at the school level. The main problem had to do with the passive involvement of principals and practicing teachers other than MEIS teachers who were involved in the training (cf. Fishman, 2005). Roles of principals for the schools were limited to selecting teachers from their various schools to attend the respective training programmes. Just as the heads, the other subject teachers were not in the known of the project, the rationale behind it and what it tended to achieve. Obviously this predisposition is likely to enhance ownership of the innovation, increase the tendency to discourage the MEIS teachers' efforts to scale up the training ideas to other teachers. Improving communications between the project implementers and the schools and scaling up the training to involve other teachers are key in promoting ownership at the school levels.

Transfer of learning to a little extent was demonstrated in some MEIS teachers' high enthusiasm to apply the new knowledge and skills about the ICT training programme. Findings from study showed that, after several months of finishing the training programme, most teachers still held strong positive pedagogical views about ideas of the training programme and made attempts to employ aspects of it but these attempts were limited to their own professional development levels.

Practicability problems resulted from a complex interaction of several variables. However, it appeared that the underpinning factors had to do with unfavourable cultures existing in schools,

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limited ICT facilities and attitudes of teachers. Although the project achieved success in equipping the schools with the projected ICT facilities, more needs to be done in terms of accessibilities to promote teaching and learning with ICTs in the schools. This findings support the contention that the extent of access to ICT facilities in schools can foster or hinder ICT-based innovation use in teaching and learning (Tondeur, Valcke, & Van Braak, 2008)

It is therefore necessary to emphasize just as Agyei and Voogt (2014) reported that, if the goal of transforming teaching and learning through ICT-based innovations is to move beyond rhetoric, many bridges exist to be crossed at the teacher and school levels as well as teacher preparation progarmmes and other stakeholders.

Towards sustainable integration of ICT innovations in teachers' teaching practices

Based on the outcomes of the study, recommendations are provided to aid smoothen the transition from teacher ICT-PDPs to actual classroom implementations in Ghanaian SHSs and such similar contexts:

- The maintenance of a professional learning culture among teachers in the senior High schools will require heads of institutions/principals as well as management of school to support institutional change. There is a need for principal and heads of institutions themselves to be well informed and updated with the potentials of ICT use in education and knowledge and skills teachers need to be able to integrate ICT in their educational practice. In addition to providing training for classroom teachers, it would be worthwhile for project implementers also to organize such training programmes for school heads and management periodically. Involving the heads in such a manner will inform the sense of ownership after such training programmes and enhance their supervisory roles.

- At school level, there is an urgent need to resolve difficult dilemmas in the terrain of ICT and technological pedagogical knowledge; innovative school culture such as: school-based in-service training (INSET) opportunities, flexibility of classroom timetable and willingness to change existing traditional approaches should be promoted. This study therefore recommends that the Ghana Education Service strengthen and enforce policies regarding the practical use of ICT for educational practices in the curriculum. A clear articulation of policy within the framework of the teacher education department and secondary education department could ensure better grounding of ICT integration in secondary education in Ghana.

- In the midst of lack of ICT facilities, teachers must make choices about the continued use of ICT-based innovative materials within their existing support structures and school environment conditions. The study recommends that principals and school leaders provide supervisory and the necessary pedagogical leadership in ICT integration. They should also provide motivation (e.g. award schemes) to promote the use of ICT-based innovations in schools.

- At the teacher level, conscious efforts to use existing hardware and software in creative and situation specific ways to design and enact ICT-enhanced activity-based learning activities to accomplish teaching goals are to be encouraged. It is recommended that school

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management lend their support by providing opportunities for teachers to learn technology by collaborative designs. In-service trainings could be a means to provide such a support.

- Parent Teachers' Association, School Management and Boards must join forces and put priority on the provision of ICT facilities in Ghanaian schools (e.g. mathematics laboratories, computers and projection devices in classrooms) to facilitate and increase access to ICT of teachers. Easy access to ICT facilities will certainly contribute to teachers' use of ICT innovations in schools (cf. Agyei, 2012).

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