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# Advancing perspectives of sustainability and large-scale implementation of design teams in Ghana's polytechnics: Issues and opportunities

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ABSTRACT

Polytechnic staff perspectives are sought on the sustainability and large-scale implementation of design teams (DT), as a means for collaborative curriculum design and teacher professional development in Ghana's polytechnics, months after implementation. Data indicates that teachers still collaborate in DTs for curriculum design and professional development. Leaders support the sustenance of DTs however internal policies are needed for its official recognition. The local role of DTs in sustaining relevant polytechnic education and training efficient manpower for national development is discussed. Some identified inherent opportunities are examined for sustenance and conclusions drawn based on programme characteristics, contextual features and polytechnic climate.



## 1. Introduction

The development of new curricula is a common event in countries across the globe and was the case of polytechnics in Ghana from 2007. The Polytechnic Law 745 was promulgated to give legal backing to the running of degree programmes called Bachelor of Technology (B.Tech.) in addition to Higher National Diploma (HND) programmes. After acquiring the status of higher education institutions of vocational learning by law, the polytechnics embarked on rigorous curriculum reform. One of the major internal challenges faced by the polytechnics in meeting the demands of relevant curriculum and quality teaching and learning was the professional development of teachers (Nsiah-Gyabaah, 2005; Gervedink Nijhuis et al., 2009) as curriculum design became their responsibility. A study conducted by Bakah et al. (in press) among the polytechnic staff to find out professional development needs of teachers revealed that the teachers wanted to improve on their knowledge and skills through industrial attachment so as to confidently engage in curriculum design. Based on the findings of Bakah et al. (in press) an intervention was designed which employed a collaborative approach to curriculum design in design teams to support lecturers in redesigning the HND programmes. The use of collaborative curriculum design was considered due to its workable, cohesive and interactive nature and as an effective professional development strategy among teachers (Mishra et al., 2007; Millar et al., 2006; Nieveen et al., 2005; Parchmann et al., 2006; Penuel et al., 2007; Simmie, 2007). A design team is a group of at least two teachers, from the same or related subjects, working together on a regular basis, with the goal to redesign and enact (a part of) their common curriculum (Handelzalts, 2009). The design team concept provides teachers with a creative space to reconsider the teaching of their subject, the intellectual stimulus of working together and the challenge to move the thinking forward; in this way, teachers are invited to become curriculum makers (Simmie, 2007). Designing by teams is one current popular means by which teachers can collectively participate in curriculum design, fulfil their learning, social and intellectual needs and are effective in bringing about teacher professional development (Borko, 2004; Deketelaere and Kelchtermans, 1996; Nieveen et al., 2005; Penuel et al., 2009).

Two iterative studies using design teams in collaborative curriculum design among engineering teachers were conducted in two polytechnics. Findings from the first intervention showed that participants acquired relevant knowledge and skills during the intervention (Bakah et al., 2011). Furthermore, collaborative curriculum design enabled active learning and improved cooperation, and dialogue on subject matter among teachers, and was a useful means for their professional development (Bakah et al., 2011). The results of the second intervention also revealed that teachers successfully redesigned their courses in design teams which impacted positively on their professional knowledge and on their classroom practices (Bakah et al., submitted for publication-a). Still in the second intervention, Clarke and Hollingsworth's (2002) Interconnected Model for Professional Growth was used to

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trace individual teachers' professional growth during collaborative curriculum design activities. Results revealed that group discussions of subject matter in the design process as well as teachers' industrial visit in teams improved individual knowledge with an exhibition of idiosyncratic sensitivity to the complex interactions with content and teaching (Bakah et al., submitted for publication-b). The success of the interventions gives credence to the elements of collaborative curriculum design as a useful means of bringing polytechnic teachers together to decide on the curriculum while in the process, updating their knowledge in their domains. Eighteen and eight months after the first and second interventions respectively, curriculum design is still an on-going process in the polytechnics and largely the responsibility of teachers. Thus the aim of this present study is to examine to what extent the intervention has proven to be sustainable and what the potentials and conditions are for large-scale implementation in Ghana's polytechnics.

### 1.1. Polytechnics and national development

A key objective of up-grading the polytechnic was to improve output particularly in technical and vocational level training. In 1991, Government of Ghana White Paper on the reforms to the tertiary education system specifically stated that the polytechnics have a distinctive and important role to play in middle level manpower development (Owusu-Agyeman and Oosterkamp van den, 2009). The reforms were predicated on the fact that Ghana needed skilled and educated entrepreneurs, managers and leaders to feed into the development strategy of the country. The Polytechnics Act 745 therefore mandates the polytechnics to conduct research, train and develop skills relevant for the job sectors to enhance their productivity and efficiency. The Growth and Poverty Reduction Strategy II under the purview of the National Development Planning Committee spells out the national development agenda of the country of which polytechnic graduates are to serve as part of the key human resources for quality and efficient public service delivery in order to speed up the growth of the private sectors. The outputs from polytechnics are expected to align with efficient and effective manpower demand in both the public and private sectors. Polytechnics are to contribute to Ghana's employment and human resource capacity building by providing technological and commercial education at tertiary level and to provide other related services such as research and consultancy to improve productivity in industry and commerce (Afeti, 2005). In general, polytechnics aim at promoting industrialization and economic development in Ghana and most polytechnic products are found in industries and the service sectors of Ghana. The polytechnic teacher has a role to play in the training of students to be responsive to rapidly changing student and workforce needs. Therefore sustaining teamwork among polytechnic teachers is needed to enable cooperation for relevant curricula and effective teaching and learning.

## 2. Theoretical underpinnings

### 2.1. Programme sustainability

The term sustainability implies the continuation of a programme in some way. Stoll et al. (2006) used sustainability to represent elements of continuous growth that is necessary for change where emphases of meaning have been noted to include whether the focus is on continuation of the benefits of the programme to the stakeholders/participants; the perseverance of the new initiative itself; or the process of developing local capacity to enable a programme to be maintained at the stakeholder/institution level. Sustainability may constitute a distinct stage of programme development in recognition of particular requirements for sustained use in the areas of, for example, training (Elias et al., 2003; Osganian et al., 2003). It has also been suggested that the process of programme development (including sustainability) cannot be understood in isolation from the context in which the programme is operating (Goodson et al., 2001; Harvey and Hurworth, 2006). From this position, actions undertaken to initiate sustained use are mediated through the different structures and practices within individual settings and so create a unique set of factors for establishing sustainability. Further, it has been indicated that the necessary conditions required for sustainability need to be planned for at the early stages of programme development (Paine-Andrews et al., 2000). Therefore, these understandings tend to suggest that sustainability may develop from a more interactive relationship between the different stages of programme development and may not be based on a simple linear process (Harvey and Hurworth, 2006).

From a more general perspective, sustainability in educational change involves maintaining improvement over time, learning gains for everyone, and not only a few, support by attainable or available resources and opportunities for diverse solutions and flexibility (Hargreaves and Fink, 2000). On system level sustainability of a professional development programme is demonstrated by the extent to which the professional development concept is accepted and implemented by different schools in an administrative region persistently (Todorova and Osburg, 2009). Necessary conditions for sustainability are the participation in the programme of a large proportion of the teachers in schools, teachers' positive attitudes and satisfaction with the course, availability of support and transfer of the goals, content and methodology of the programme (Todorova and Osburg, 2009).

### 2.2. Leadership

The factors which influence the sustainability of a professional development initiative are specific in every case and actions for improvement and can be taken when the stakeholders in the school system appreciate its value. Hipp et al. (2008) in a study on sustaining learning communities showed that teachers and leaders exhibited determination to build and sustain the culture of a professional learning community. Thus, how the school visions become reality through what the staffs do is critical to achieving school reform (Fullan, 2000; Mitchell and Sackney, 2001). Successful reform requires purposeful action based on commitment to change. In this regard, the central importance to school-based programme implementation is the support of leadership through the provision of structures, strategies and supports on the path to change (Elias et al., 2003; Kam et al., 2003; Supovitz and Christman, 2003). Continuous improvement in schools is directly related to the breadth and depth of leadership in the school as Hargreaves and Fink (2006) state. Sustainable leadership acts urgently, learns from the past and from diversity, is resilient under pressure, waits patiently for results, and does not burn people out. In fact, leaders in schools that maintain learning and growth over time embrace change and provide supports for staff and students throughout the change process.

### 2.3. Up scaling

After decades of intense educational reform, educators, policymakers, and researchers still grapple with the question of how pockets of successful reform efforts might be "scaled up." Most research on scale tends to define what it means to "scale up" an external reform in quantitative terms, focusing on increasing the number of teachers, schools, or districts involved (Coburn, 2003; Datnow et al., 2002; Hargreaves and Fink, 2000; Legters et al., 2002).

Stringfield and Datnow (1998) define scaling up as 'the deliberate expansion to many settings of an externally developed school restructuring design that previously has been used successfully in one or a small number of school settings' (p. 271). Despite this simple definition, Coburn (2003) states that it says nothing about the nature of the change envisioned or enacted or the degree to which it is sustained, or the degree to which schools and teachers have the knowledge and authority to continue to grow the reform over time. While the idea of sustainability is fundamental to scale-up, few conceptualizations address it explicitly. It only rarely appears in theoretical and empirical pieces (McLaughlin and Mitra, 2001). Most discussions address issues of sustainability and scale separately, obscuring the way that scale, in fact, depends upon sustainability (Coburn, 2003). While there is ample evidence that sustainability may be the central challenge of bringing reforms to scale. Schools that successfully implement reforms find it difficult to sustain them in the face of competing priorities, changing demands, and teacher and administrator turnover (Berends et al., 2002; Hargreaves and Fink, 2000; Hatch, 2000; McLaughlin and Mitra, 2001). Scaling up involves adapting an innovation successful in a local setting to effective usage in a wide range of contexts (Dede, 2006). In contrast to experiences in other sectors of society, scaling up successful programmes is very difficult in education (Dede et al., 2005). Scalable designs for educational transformation must avoid what Wiske and Perkins (2005) term the 'replica trap': the erroneous strategy of trying to repeat everywhere what worked locally, without taking account of local variations in needs and environments. For example, the one-size-fits-all model, does not fit when scaling up in education, because a pedagogical strategy that is successful in one particular classroom setting, with one particular group of students frequently, will not succeed in a different classroom with different students. This suggests the need for a renewed and vigorous dialogue, not just about the challenges of sustainability, but about strategies for providing schools with the tools they will need to sustain the reform (Coburn, 2003). Dede and Honan (2005) identify 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.
4. *Effective decision making:* interpreting data; creating and applying usable knowledge.

In the context of innovations in teaching/curriculum, Coburn (2003) describes scale as encompassing four interrelated dimensions: depth, sustainability, spread, and shift in reform ownership. "Depth" refers to deep and consequential change in classroom practice, altering teachers' beliefs, norms of social interaction, and pedagogical principles as enacted in the curriculum. "Sustainability" involves maintaining these consequential changes over substantial periods of time, and "spread" is based on the diffusion of the innovation to large numbers of classrooms and schools. "Shift" requires districts, schools, and teachers to assume ownership of the innovation, deepening, sustaining, and spreading its impacts. A fifth possible dimension to extend Coburn's framework is "evolution," in which the innovation as revised by its adapters is influential in reshaping the thinking of its designers, creating a community of practice that evolves the innovation (Dede, 2006). The explicit focus on sustainability as a key element of scale also has implications for research design (Coburn, 2003). Other studies in the literature on scale employ designs that sample schools with a range of years of experience participating in the reform (Datnow et al., 2000). In particular, design for sustainability centres on the issue of contextual variation and involves designing educational innovations to function effectively across a range of relatively inhospitable settings (Dede, 2006). Placing reform ownership as a central element of scale raises the priority for directing reform attention and resources to strategies that have the potential for enabling schools and districts to assume ownership for the reform over time (Coburn, 2003).

### 2.4. Educational change

The use of change theory to embed effective change practices into a programme and its implementation process is critical (Harvey and Hurworth, 2006). These structures are linked with a number of the noted sustainability factors such as mutual adaptability, establishing programme champions and assisting school ownership. Of interest these change elements appear to be most effective where schools themselves demonstrated an overt understanding of the process of school change (Harvey and Hurworth, 2006). Teachers are better able to sustain change when there are mechanisms in place at multiple levels of the system to support their efforts. This includes the presence of a supportive professional community of colleagues in the school that reinforces normative changes and provides continuing opportunities to learn (McLaughlin and Mitra, 2001; Stokes et al., 1997), knowledgeable and supportive school leadership (Berends et al., 2002; Datnow et al., 2002; Hargreaves and Fink, 2000; Legters et al., 2002; Murphy and Datnow, 2003), connections with other schools or teachers engaged in similar reform and normative coherence. Fullan (2007) has indicated that collegial relationships facilitated change because change involves learning to do something new, and interaction is the primary basis for social learning. He emphasised that new meanings, new behaviours, new skills, and new beliefs are highly dependent on whether teachers are working as isolated individuals or are exchanging ideas, support and positive feelings about their work. As revealed in a secondary school study by Andrews and Lewis (2002), change in teachers' classroom practices grew out of shared purpose, shared experience and professional dialogue. In this study, we investigate the sustainability and up-scale of design teams in Ghana's polytechnics, a means by which teachers can continuously engage in collaborative curriculum design and learn from it. Up scaling in this regard is expected to occur in terms of spreading of design teams to other departments and among teachers, increasing teachers' beliefs about social interaction and professional development, maintaining design teams and assuming ownership. Even though teachers have been the target in this collaborative initiative, its sustainability is considered the concern of both teachers and leadership.

The main research question which guided the study was: *What is the potential for sustainability and large-scale implementation of design teams in the polytechnic?* The following sub-research questions were formulated to answer the main research question.

1. Have design teams been sustained in Ho and Takoradi polytechnics?
2. What are teachers' (with and without design team experience) perceptions of design teams as a means for their professional development and to attain curriculum reform?
3. What are the conditions and necessary support for a sustainable and large-scale implementation of design teams according to teachers and leadership?

## 3. Methods

As indicated earlier, this study is a sustainability study which grew out of a larger programme of research where the investigative

**Table 1**
Internal consistency reliability for three sub-scales of the teachers' design team perceptions.

| Sub-scale | Cronbach's alpha ($\alpha$) | Items ($n = 63$) | Factor loadings |
|---|---|---|---|
| Professional development | 0.91 | I can improve my content knowledge in a design team | 0.74 |
| | | I can obtain new ideas for my course in a design team | 0.71 |
| | | I like the idea of visiting industry in design team | 0.65 |
| | | I find it important to share knowledge in design team | 0.63 |
| | | I learnt from colleagues in design team | 0.63 |
| | | Design teams is a useful tool for teacher professional growth | 0.58 |
| | | I wish to always be part of design team to visit industry | 0.53 |
| | | Design team is recommendable for all teachers for their learning | 0.52 |
| Collaboration | 0.80 | Design team is a source for teacher collaboration | 0.80 |
| | | Design teams engages me in subject matter discussions | 0.67 |
| | | I like collaboration so far with fellow teachers in design team | 0.59 |
| | | It's easy to discuss subject matter challenges in design team | 0.59 |
| | | We cooperate with each other in design team | 0.58 |
| | | I like teamwork in design teams | 0.57 |
| | | I open up to my colleagues on challenges I face in my course | 0.51 |
| Curriculum design | 0.81 | Using design team to identify learning needs interesting | 0.84 |
| | | Using design team to evaluate course content is useful | 0.71 |
| | | I like curriculum design in design teams | 0.63 |
| | | Design team is useful for solutions to challenges in my subject | 0.59 |
| | | Design team helped to integrate new knowledge into my teaching | 0.59 |

site is polytechnics in Ghana. Thus, the cross-sectional survey method (Gray, 2004) is employed in which qualitative and quantitative data collection techniques (Yin, 1993) were used to find out teachers' and leaders' perceptions of the sustainability and large-scale implementation of design teams in the polytechnics.

### 3.1. Participants

The 29 teachers (13 and 16 from Ho and Takoradi Polytechnics respectively) in the design teams described in the introduction above were involved in this study. They were all from the faculty of engineering. Furthermore, 34 teachers (16 from Ho and 18 from Takoradi Polytechnics) who were not members of the design teams also were randomly selected for the study. Persons in leadership at the same polytechnics were also involved. These were vice-rectors (2), registrars for human resource (2), faculty deans (2) and heads of department (4). The faculty deans and heads of department were directly involved in facilitating the design teams' activities during the intervention.

### 3.2. Instruments

Questionnaires, interviews and focus group interviews were employed to gather data and find out teachers' and leaders' perspectives of the sustainability and up-scale of design teams in the polytechnics. Teachers' responded to close-ended five-point Likert-scale questionnaire items, with one being strongly disagree to five being strongly agree. The scores are interpreted as follows: one is the lowest possible score, which represents a very strong negative attitude, while five is the highest possible score which represents a very strong positive attitude. Teachers who were participants in the design teams were engaged in a focus group interview of between four and six teachers lasting for a minimum of 2 h per session. Leadership responded to a semi-structured interview guide in a face-to-face interview lasting about 45 min per session.

### 3.3. Data analysis

Thirty items were used to explore the perceptions of teachers who were participants and non-participants in design teams. After a factor analysis using PASW Statistics, 20 out of the 30 items were selected as high loadings on the extracted factors after an exploratory factor analysis. In all, three sub-scales were used: professional development (the value of design teams for teacher learning). Collaboration (the act of cooperating, working jointly and group effort in design teams) and curriculum design (the importance of design teams for collaborative curriculum design). Means and standard deviations (SD) were computed for the sub-scales. Table 1 shows the internal consistency reliabilities for the design team perceptions sub-scales and the factor loadings for the selected items as reported by the teachers.

*T*-test was computed to find out whether significant differences existed regarding the perceptions of participants and non-participants in the intervention. Analysis of comparison of data among teachers who participated in the intervention (total 29) employed the Mann–Whitney U non-parametric test (Fay and Proschan, 2010) on assumption that the population cannot be assumed to be normally distributed. Where significant differences were found, effect size was calculated using Cohen's $d$ (Cohen, 1988) to find out the extent of the differences. Cohen (1988) provided tentative benchmarks for the interpretation of effect sizes being $d = 0.2$ a small, $d = 0.5$ a medium and $d = 0.8$ a large effect size.

All interviews were transcribed and coded using codes generated from the study. The coding schemes (Miles and Huberman, 1994) were labelled: *implementation*, *perceptions*, *sustainability* and *up-scaling*. Atlas-ti software version 6.2 was used for the coding of all the interview data. Intercoder reliability (Lombard et al., 2002; Tinsley and Weiss, 2000) was calculated using a random sample of five interviews from 10 leaders and three focus group interviews out of six. There were two coders including the first author of this article. The intercoder reliability using Cohen's kappa ($k$) was 0.87 (interviews) and 0.81 (focus group interviews).

## 4. Sustaining design teams

### 4.1. Teachers' disclosures

All teachers' displayed a level of attachment to design teams several months after the collaborative curriculum design activities. Some of the features of their continuous use of teamwork were part of the original activities that formed design team work earlier on. In Table 2, very high means (above mean = 4.06, SD = 0.57) were recorded from the teachers' responses in the two polytechnics. Collaborative curriculum design was still a feature among them as shown by items two, five and six while items one, three and four

**Table 2**
Current use and state of design teams.

| Activities and experiences | Polytechnic | | | | |
|---|---|---|---|---|---|
| | Ho ($n = 13$) | | Takoradi ($n = 16$) | | Sig. |
| | M | SD | M | SD | |
| Original teams | | | | | |
| 1. I still visit industry in a design team | 4.08 | 0.76 | 4.06 | 0.57 | 0.921 |
| 2. We share information about our courses in design teams | 4.46 | 0.52 | 4.44 | 0.51 | 0.899 |
| 3. We visit industries in design teams to update our knowledge | 4.38 | 0.51 | 4.50 | 0.52 | 0.541 |
| 4. Design teams still use industry information from previous visits | 4.23 | 0.73 | 4.19 | 0.66 | 0.827 |
| 5. We still work in design teams for curriculum design | 4.15 | 0.56 | 4.38 | 0.81 | 0.270 |
| 6. Design teams evaluate teaching of updated courses | 4.46 | 0.51 | 4.50 | 0.52 | 0.839 |
| 7. Design team meetings are held regularly | 4.62 | 0.51 | 4.25 | 0.78 | 0.204 |
| 8. I engage in all design team activities | 4.62 | 0.51 | 4.63 | 0.50 | 0.958 |
| Expanded/new teams | | | | | |
| 9. Other teachers have joined design teams | 4.15 | 0.56 | 4.00 | 0.82 | 0.597 |
| 10. Design teams have expanded to other departments | 4.38 | 0.51 | 4.56 | 0.51 | 0.349 |

*Note*: M, mean; SD, standard deviation.

are proofs that teachers engage in design teams for their professional development. Other items such as seven and eight portray the furtherance of design teams. Teachers confirmed that new members joined their design teams as well as the expansion of design teams to other departments within their polytechnic (see items nine and 10). Interestingly, no significant differences ($p > 0.05$) existed between the two polytechnics on teachers' outlooks as presented in Table 2.

Aside being members of recognised design teams in their departments, teachers formed their own teams of three or four due to a core subject they teach in order to share ideas on the content and maintain consistency in the information they transmit to their students. The aforementioned was especially among automobile and electrical teachers in Takoradi Polytechnic (T'Poly) and the electrical teachers in Ho Polytechnic (H'Poly) as in the following statement from a teacher in H'Poly:

> The students are in groups for practical lessons handled by three of us. Initially we did not coordinate but after the design team experience, we decided to team up and harmonize what we do and even plan lessons ... we undertook an industry trip to Akosombo hydroelectric plant for information to supplement what we teach. We are even meeting in the next two hours on fluid mechanics.

Another teacher at T'Poly said that the components in the course is shared among four of them in the areas of welding, theory and practice, manufacturing technology and workshop practice so they formed a team to share knowledge on the course. That teacher concluded by saying, 'So far knowledge shared has promoted the course'. All the teachers except those in H'Poly automobile and T'Poly production, with no tangible reason, have sustained the momentum of undertaking industry trips in their design teams. For instance, the automobile teachers in T'Poly visited the Volta Lake Transport to study transport management, likewise the electrical teachers in T'Poly confirmed that they undertook an interesting trip to the Kpong hydro generation station for a study on turbines, generators and grid-energy storage. Another major activity of design teams which teachers to a large extent held on to was curriculum design. The production teachers in H'Poly informed that they made certain major recommendations for the syllabus in their team which have been approved. This was an encouragement to them as one of them remarked, 'Design team has come to stay'. At H'Poly, two of the original design teams (Automobile and Production) had new members joining while at T'Poly, three original design teams (Automobile, Electrical, Production) also had new membership. Despite the efforts at maintaining the existence of design teams, some challenges have been encountered. The teachers pointed out that long term sabbatical or study leave of teachers affect their design team participation while meeting times were in some cases difficult to locate due to conflicting timetables.

### 4.2. Leadership observations

All persons in leadership position in this study were fully aware of the existence of design teams in some departments in their polytechnics and were generally in favour of its existence. A registrar at T'Poly revealed:

> Management is aware of the teamwork among the electrical, civil and mechanical engineering department teachers and sees it as a relevant measure of teacher cohesion, development and curriculum design.

An engineering faculty dean in T'Poly informed that he was personally involved in forming design teams of three teachers who design students' laboratory lessons in the electrical and production departments and have pre-practical lesson meetings and hopes it will spread to other departments. In H'Poly the engineering faculty dean was aware of design teams and their activities in the faculty. The dean stated that the teams have been planning and undertaking industrial visits.

According to T'Poly vice-rector, most of the departments are adopting competency-based teaching and learning which takes the collective effort of all the staff to really groom students to become competent. Thus the dean continued that:

> ... To eschew teaching along parallel lines the civil engineering teachers, for instance, are currently working in teams to design and teach the competency-based courses. In fact, these teachers in teams of two and three, make follow-up on students undergoing industrial attachment.

This teamwork under competency-based training is also on-going in teams in the agriculture engineering department of H'Poly as confirmed by their vice-rector who indicated that teachers came together in design teams to update their courses. A registrar at H'Poly pointed out that:

> You know, it is a requirement that as a teacher, you update knowledge and also do research. Therefore by taking advantage of design teams to visit industry, develop the curriculum and so on, the result is knowledge update which is a form of motivation ... so most teachers are interested doing such activities. The teachers meet in teams without hesitation.

Most of the leaders were of the view that the on-going operation of design teams among teachers in some departments in the faculty of engineering has yielded results in terms of teachers' professional development, collegial interaction and syllabus reviews. They acknowledged that it was time to set up design teams as part of the polytechnic system.

## 5. Teachers' perceptions of design teams

Table 3 shows that teachers who participated in design team activities highly rated it with means above 4.00. However, its usefulness for their professional development was rated highest by all the teachers in both H'Poly and T'Poly followed by collaboration and then curriculum design. Notable in the results is the similarity in sequence of teachers' perception of design teams from different polytechnics. Meanwhile no significant difference ($p > 0.05$) existed between the two polytechnics in terms of all the variables listed in Table 3.

The results as in Table 3 indicate that professional growth, teacher cohesion and curriculum design are important for teachers as that is needed for their continuous effectiveness in content and teaching. This is further buttressed by the teachers during focus group interviews as one of them in T'Poly indicated that:

> The motivating factor to be in design team is that we are likely to gain more knowledge, acquire new ideas and improve our teaching ... by way of delivery, by way of content and so on.

In Table 4, results establish the magnitude of design team impact on teachers who experienced it as against those who are not yet members. Significant differences ($p < 0.05$) existed among participants and non-participants in terms of professional development, collaboration and curriculum design with participants appreciating design teams more than non-participants. There were high effect sizes for all three components as in Table 4. Nevertheless, it is worth noting that the means and standard deviations of the non-participants were quite high and thus show that they have high regard for design teams.

## 6. Conditions and support necessary to up-scale design teams

All teachers, whether participant or non-participants in the intervention, responded to items on means by which design teams can be sustained and up scaled in the polytechnics. The items were categorised according to the interrelated dimensions of scale by Coburn (2003) which are depth, sustainability, spread, shift and evolution in reform ownership. The occurrence of these dimensions (see Table 5) is relatively equal. In Table 5, a comparison is made between all teachers who are design team members and those who are not (using independent samples $t$-test), regarding their responses to conditions and support needed to scale-up design teams. Results show that significant differences ($p < 0.05$) were present between participant and non-participant teachers for 16 out of the 18 items. All the teachers see the need for design teams to spread across the polytechnic and should be done through creating its awareness and formal recognition in the polytechnics. Generally medium (item 5, $d = 0.65$) to large (item 15, $d = 1.07$) effect sizes were found for the 16 items in Table 5 which indicates that the intervention had positive effects on teachers who participated in it and thus they agree more to conditions and support necessary to scale-up design teams.

The results of only design team participant teachers (29) were compared by polytechnic, regarding the conditions and support necessary to scale-up design teams. Using the output of a non-parametric Mann–Whitney U test revealed high means (above 4.00) and standard deviations for all the items among the teachers in the two polytechnics. However, significant differences ($p < 0.05$) with large effect sizes existed between teachers in the two polytechnics related to four out of the 18 items in favour of T'Poly teachers which is much larger and older among the two polytechnics. The effect sizes for the four items are: there should be a design team coordination team ($d = 0.83$); management should organise design team awareness seminars ($d = 0.85$); design team should have representation on curriculum committees ($d = 0.96$) and record keeping should be done at design teams ($d = 1.01$).

During the teacher group interviews, a number of issues were raised for the sustainability and large-scale implementation of design teams in the polytechnics. Some factors identified were common to the two polytechnics as for example most of teachers were generally of the view that much depends on them to build

**Table 3**
Teachers' perceptions of design teams by polytechnic.

| Design team perception | Polytechnic | | | | |
|---|---|---|---|---|---|
| | Ho ($n = 13$) | | Takoradi ($n = 16$) | | Sig. |
| | M | SD | M | SD | |
| Professional development | 4.46 | 0.19 | 4.57 | 0.26 | 0.199 |
| Collaboration | 4.42 | 0.32 | 4.34 | 0.34 | 0.278 |
| Curriculum design | 4.36 | 0.33 | 4.03 | 0.62 | 0.164 |

M, mean; SD, standard deviation.

**Table 4**
Teachers' perceptions of design team by participation.

| Design team perception | Participation in design team | | | | | |
|---|---|---|---|---|---|---|
| | Participants ($n = 29$) | | Non-participants ($n = 34$) | | Sig. | Effect size |
| | M | SD | M | SD | | |
| Professional development | 4.52 | 0.24 | 3.95 | 0.50 | 0.0001* | 1.45 |
| Collaboration | 4.37 | 0.33 | 4.10 | 0.54 | 0.021* | 0.60 |
| Curriculum design | 4.18 | 0.53 | 3.67 | 0.55 | 0.0001* | 0.94 |

M, mean; SD, standard deviation.
* $p < 0.05$.

**Table 5**
Conditions and support necessary to scale-up design teams by teacher participation.

| Measures ($\alpha = 0.91$) | Dimensions of scale | Participation in intervention | | | | Sig. | Effect size |
|---|---|---|---|---|---|---|---|
| | | Participant ($n = 29$) | | Non-participant ($n = 34$) | | | |
| | | M | SD | M | SD | | |
| 1. DT team meetings should be made part of school schedule | SH | 4.38 | 0.56 | 3.59 | 0.89 | 0.000* | 1.06 |
| 2. Teacher development needs should be accessed through DTs | EV and SU | 4.41 | 0.50 | 3.88 | 0.81 | 0.003* | 0.79 |
| 3. DT activities should be recognised by the academic board | SU and SP | 4.62 | 0.49 | 4.09 | 0.80 | 0.003* | 0.80 |
| 4. DT activities should be reviewed at faculty board meetings | SP and SH | 4.24 | 0.44 | 3.94 | 0.78 | 0.069 | n/a |
| 5. DT activities should be given attention at departments | SP and SH | 4.41 | 0.50 | 4.00 | 0.74 | 0.013* | 0.65 |
| 6. DT activities should be publicised regularly in polytechnic | SU and SP | 4.38 | 0.49 | 3.79 | 0.88 | 0.002* | 0.83 |
| 7. Management should occasionally interact with DTs | SP and EV | 4.52 | 0.57 | 3.85 | 0.70 | 0.000* | 1.05 |
| 8. There should be a design team coordination team | SU, SP and SH | 4.34 | 0.61 | 3.79 | 0.81 | 0.004* | 0.77 |
| 9. Every teacher should be design team member | SP | 4.28 | 0.53 | 3.82 | 0.58 | 0.002* | 0.83 |
| 10. Management should organise design team awareness seminars | SU and SP | 4.34 | 0.48 | 4.18 | 0.63 | 0.243 | n/a |
| 11. DTs should have representation on curriculum committees | DP and EV | 4.69 | 0.47 | 4.15 | 0.93 | 0.006* | 0.73 |
| 12. Management should encourage curriculum design in DTs | DP, EV and SH | 4.55 | 0.57 | 3.91 | 0.79 | 0.001* | 0.93 |
| 13. Teachers in DTs should be motivated | SP | 4.52 | 0.51 | 4.12 | 0.69 | 0.012* | 0.66 |
| 14. DTs should advice management on teacher development | DP, EV and SH | 4.34 | 0.61 | 3.88 | 0.73 | 0.009* | 0.68 |
| 15. DTs should conduct regular scrutiny of the syllabus | DP, EV, SH and SU | 4.69 | 0.47 | 4.12 | 0.59 | 0.000* | 1.07 |
| 16. Sharing of ideas should be encouraged in DTs | DP, EV, SH, SU and SP | 4.59 | 0.50 | 4.18 | 0.72 | 0.012* | 0.66 |
| 17. Record keeping should be done at DT meetings | SU and SH | 4.31 | 0.47 | 3.79 | 0.88 | 0.006* | 0.74 |
| 18. DT should engage in professional development activities | DP, EV, SH and SU | 4.66 | 0.48 | 3.94 | 0.85 | 0.000* | 1.04 |

M, mean; SD, standard deviation; DT, design team; DP, depth; SU, sustainability; SP, spread; SH, shift; EV, evolution as in Coburn (2003); n/a, not applicable.
* $p < 0.05$.

effective and workable design teams in the polytechnic: through being cooperative and appreciating the value of teamwork in design teams for their professional development and curriculum design. The sensitive issue of financial motivation for design team members generated interesting but lengthy discussions and even nearly arguments. Two schools of thought emerged, being those who were for or against design team allowances. In the minority were teachers who advocated for financial motivation for design team members. A greater number of teachers were of the view that teachers in design teams should not receive monetary rewards with reasons as follows:

1. some teachers will end up in design teams because of the financial benefits
2. the meaning and purpose of curriculum design and professional development might be lost
3. the polytechnic may be unable to pay teachers if all of them decide to be design team members
4. design teams may seem like working polytechnic committees that receive sitting allowances
5. lack of finance may be an excuse for management not to push the design team agenda or delay its large-scale implementation
6. monetary affairs can easily aggravate tension and derail design team activities

The general unacceptability of financial motivation for design teams among teachers may be a partial contradiction of results in Table 5 where item 13 (teachers in design teams should be motivated) had high means from both participant (mean = 4.52, SD = 0.51) and non-participant (mean = 4.12, SD = 0.69) teachers. Motivation in Table 5 is partly non-monetary since other support (listed in Table 5) needed to sustain design teams have on the whole been advocated by the teachers. Other suggestions from teachers and leadership to facilitate the sustainability and large-scale implementation of design teams in the polytechnics were that: there should be a policy for mandatory design team membership, orientation should be organised for new design teams members, teachers' letter of appointment should oblige design team membership, criteria for teachers' promotion should include design team accomplishment and design team should be spelt out in the polytechnics strategic plan.

## 7. Discussion

This research was conducted in an effort to gain insight into the sustainability and large-scale implementation of design teams in polytechnics in Ghana. This sustainability study was conducted eighteen months after implementation of the first intervention study and eight months after implementation of the second intervention study in two polytechnics where teachers in design teams collaboratively designed their courses based on knowledge acquired from industry. Data from the two polytechnics generated an interesting cross-section of findings that provide useful insights into the design team sustainability efforts of the teachers and leadership as well as design team up-scaling in the polytechnic system. The findings show that teachers adopted strategies and methods consistent with their own knowledge and experiences with design team activities in the polytechnics within the months under review through maintaining collaborative curriculum design activities, industry visits to strengthen practical knowledge and keep abreast with industrial innovation as well as promoting effective teaching among others. This is akin to the findings of Hipp et al. (2008) in a study on sustaining professional learning communities which revealed that staff sustained professional learning communities through maintaining a collaborative and professional culture, teamwork and shared responsibility among others. As in the findings of Fullan (2000) and Mitchell and Sackney (2001) visions becoming reality through what staff do is critical to achieving school reform. The task of sustaining design teams may be challenging and difficult but worth tackling because of the potential benefits in terms of professional and curriculum development. The practices of design teams in this study are comparable to the finding of Todorova and Osburg (2009) that sustainability of a professional development programme is demonstrated by the extent to which the professional development concept is accepted and implemented persistently.

The formation of new design teams in other departments is an indication of its spread which is an aspect of scaling up (Coburn, 2003) and an indication of diffusion of design teams to other departments. A further indication of spread was the finding that new members joined most of the design teams that were formed during the intervention. These are evidences of scalability of a design in education which is in contrast to Dede et al.'s (2005) assertion that scaling up successful programmes is very difficult in education. Though the design teams have not been formally instituted by policy, they are being maintained in some departments and the awareness and benefits of design teams for professional development, collaboration and course design is valued by teachers and leadership and its enormous returns for teaching and learning are respected. To sustain design teams in the polytechnics, teachers want management to recognise and encourage design team activities. Teachers' concern for leadership support as identified in this study confirms studies of Supovitz and Christman (2003) and Hargreaves and Fink (2006) that the role of educational leaders through the provision of structures, strategies and supports are critical on the path to change. Teachers highly advocated the making of design team part of the polytechnic system but admit that it will require time, effort and commitment from themselves and leadership as is the view of Harvey and Hurworth (2006), Paine-Andrews et al. (2000) and Hipp et al. (2008). It is encouraging to discover that leadership is aware and allows the operation of design teams in the polytechnics. Meanwhile even though design teams' teacher motivation in general is acceptable among teachers, it is feared by both teachers and leadership that financial incentives in particular for design team members might hinder its smooth upscale and sustainability and therefore should not be encouraged. Suggestions by both teachers and leaders to facilitate design team sustainability and large-scale implementation weighed heavily on management in the two polytechnics to officially establish policies to encourage teachers and guide design team existence as indicated by Elias et al. (2003), Kam et al. (2003), Supovitz and Christman (2003) and Hargreaves and Fink (2006) that of central importance to school-based programme implementation is the support and leadership of the school leader through the provision of structures, strategies and supports on the path to change.

Design team challenges enumerated by teachers included heavy teacher workload as well as difficulty in locating meeting times. Thus challenges are common occurrences in sustaining programmes as Berends et al. (2002), Hargreaves and Fink (2000) and McLaughlin and Mitra (2001) state that competing priorities, changing demands and teacher and administrator turnover are some of the challenges in the sustainability of educational programme. Despite the challenges, there are some opportunities which offer fertile ground for design team sustainability in polytechnics. Perhaps the most significant opportunity being that both teachers and leadership do not perceive the sustenance and scaling up of design teams as an arduous task. Such positive stance confirms the finding of Todorova and Osburg (2009) that positive attitudes of teachers and leadership are a necessary condition for sustainability. Teachers and leadership are basically aware of the usefulness of and value design teams due to their past experiences with it. Furthermore, leadership see the worth of design teams and show commitment to its course and also the polytechnics are autonomous institutions which can easily make their internal decisions without outside interference. Design teams encourage collegial relationships and provide continuing opportunities to learn which is in itself a catalyst for change and is similar to Andrews and Lewis's (2002) finding that change among teachers grew out of shared purpose, shared experience and professional dialogue. There is the potential of sustainability however, for design teams to be incorporated in the polytechnic structure it needs to be better managed by polytechnic regulation. At length, promoting factors revealed in this study make us conclude that design team sustainability is more likely to continue.

Demand for tertiary education is seen as very important for the development of every country and the training of the productive workforce who are involved in the provision of the basic needs of society and services needed to run the economy. One of the objectives of polytechnic education in Ghana is to develop programmes that enhance quality to meet both students' demand and the market which would absorb the students upon completion of their programmes. The teachers form part of the stakeholders in maintaining quality polytechnic education therefore this study aimed at identifying the factors for sustaining design teams among teachers through which they can develop professionally, conduct research to impact on their contribution to curriculum design as well as their classroom practices. Although the government has lots of responsibilities towards the provision of quality polytechnic education in Ghana, much rests on the internal structures of the polytechnic to meet the increasing demand for relevant curriculum. The teacher design team approach in polytechnics could be seen as very important local role for the sustenance of a learning environment which could help the polytechnics meet its obligations in providing quality education for students in the institution. The benefits of such collaboration in design teams could include teachers' keeping up-to date knowledge of industry operations through polytechnic and industry collaborations in order to meet the demands of industry and commerce for skill development. When polytechnics teachers are allowed to design and implement their own professional development programmes in design teams, it will not only motivate the actors involved but more importantly provide innovation needed in the development of polytechnics in Ghana. The strength of economy depends on its work force and the training of efficient middle-level manpower would eventually help in the socioeconomic development of Ghana.

## 8. Conclusion

This study illuminates some characteristics of sustainability of design teams in educational institutions particularly higher education contexts and challenges on the path to change. Large-scale implementation and sustainability of design teams seem promising due to supportive factors such as the maintenance and expansion of original design teams and staff awareness and commitment. It can be said that design team is a recognised part of the on-going system in some departments in the two polytechnics and has opportunities for teachers to learn and practice innovative approaches over a prolonged period of time, to work collaboratively on authentic design tasks and to influence the choice of activities towards addressing their learning needs. There are visible advantageous conditions, such as appreciation of collaboration by teachers and leaders, to sustain teamwork in design teams in the polytechnics. Teachers adopted strategies and methods consistent with their own knowledge and experiences with design teams, such as course update and industry visits. Teachers and leadership in educational institutions have found themselves battling with change especially initiated by national, state or local authorities to raise standards of achievement. However in this case, the teachers and leaders find themselves in higher institutions that are autonomous thus can take priority over their own vision of desirable improvements; especially as the study has shown an environment of promising opportunities. As circumstances in the polytechnics have so far permitted, it makes sense for polytechnic leaders to aim to promote design teams based on the institutional strength, that is, a clear articulation of goals and objectives and internal guidelines for operation.

## 9. Reflection on outcomes

Studying adaptability and scalability and then examining their validity and value is an important frontier for sustainable reform which will measure the degree to which the educational effectiveness of a design is robust despite attenuation of its conditions for success. Through identifying factors within the intervention's context that represent important conditions for success and summarizing the extent to which the effect of the intervention is sensitive to variation in each, we could provide prospective adopters of the intervention a better sense of what its likely effectiveness could be in their own particular circumstances. The detailed programme design and supporting implementation strategy helped to sustain use of design teams at the polytechnics. The underlying design of design teams emphasised teacher and leadership involvement and ownership, identification of learning needs, links with existing policies and structures regarding curriculum design and an already pending need for teacher development to support the polytechnic reform process. An additional feature that also appeared to assist with the continuous use of design teams was the use of evidence-informed research in the development of the programme. Understandings of best practice in teamwork among teachers were combined with current knowledge about design team usage for collaborative curriculum design. The use of this broad theoretical underpinning appeared to strengthen the specific design of the strategies for planning and implementing collaborative curriculum design through design teams. The components of collaborative curriculum design were set in a purposeful and tangible process of curriculum reform in Ghana's polytechnics. Another essential component of the strategy was the formation of a group of design teams by committed teachers, particularly in the older polytechnics. These were teachers who became dedicated to the initiative and made sure that knowledge learnt in the industries was applied to other areas of the curriculum. In addition, design team is genuinely a 'living place' within the polytechnic with teachers working on improving knowledge, curriculum, teaching and learning. The already collegial relationship which characterises design teams is supportive and a mechanism to reinforce normative change and provide continuing opportunities to learn. The most important supportive contextual feature for sustained design team use was generally based on the leaders' support of especially heads of department and faculty deans. This boosted teachers' enthusiasm since some of these heads encouraged the formation of new design teams. Most teachers had a clear commitment to continuous improvement and saw the design teams as useful means for this process. We are however conscious of the fact that the process of re-culturing the polytechnic teachers as professional learning teams is a journey as evidenced by the time, energy and resources being exerted to move from implementation to sustainability.

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