Online Continuing Professional Development: Tensions Impacting on the Reflective Use of a Mathematics-friendly Forum Environment

Abstract

The Internet seems full of potential as a catalyst for the Continuous Professional Development (CPD) of geographically dispersed teachers. Having developed a mathematics-friendly online discussion forum environment, we investigated the personal and situational tensions that impacted on the use of this forum environment as a reflective tool for the CPD of advantaged and disadvantaged mathematics teachers in the South Africa context of disparities. Using elements of Grounded Theory and Activity Theory in a Case study approach, the research identified various tensions that impacted on the use of the environment.

1. Introduction

In 1994/1995, South Africa became part of the largest and most ambitious international study of mathematics and science ever undertaken by the International Association for Educational Achievement (1998). The Third International Mathematics and Science Study (TIMSS) involved 41 countries and half a million pupils. South African pupils performed particularly poorly in mathematics in comparison with other participating countries.

One of the issues where the data suggested action may be appropriate and where it seems feasible, was on mathematics teacher preparation, especially where it concerns teachers from previously disadvantaged communities. Half of the teachers surveyed reported they felt ill prepared to teach the content of the mathematics curriculum. There appeared to be few teachers with significant experience, with a relatively small percentage having a university level qualification. Their lack of adequate preparation in terms of content knowledge in particular leaves these teachers feeling poorly prepared to teach their pupils. While numerous national efforts are underway to advance the status and teaching of mathematics in South Africa, initiatives to foster Continuous Professional Development (CPD) are largely driven by Higher Education Institutions offering accredited distance education courses, with in-service education and training efforts largely limited to workshops offered by the various Departments of Education (DOE).

However, the usefulness of workshops or event-delivery is debated by many authors (Guskey 1986; Clark 2002; Knight 2002). As Wiske, Sick & Wirsig (2001) summarizes, workshops are inclined to focus on
general topics, are inattentive of teachers’ individual interests, are disconnected from specific classroom practices and are isolated from ongoing support. Some of the other pertinent limitations identified by Becher (1999) are costs (rural teachers, in particular, are geographically dispersed) and variability in the quality and level of CPD provision. Given the diversity of South Africa’s educational environments and the numerous echelons of educators, there is bound to be some level of disparity between provision and needs. These limitations are further enhanced in the absence of a clear CPD strategy for educators in South Africa (Mashile 2002).

Cluster meetings, where teachers gather in language groups and geographical proximities, are a new initiative that aims to overcome these shortcomings. The purpose of these meetings is to enhance ongoing faculty and course/curriculum development. There is evidence, however, that cluster meetings are not popular, possibly as a result of the greater demands it places on them and Subject Advisors (Venter 2003). More importantly, because of their geographical isolation, many teachers in rural areas will remain on the periphery of CPD opportunities like cluster meetings.

The sudden, rapid and dramatic advent of the World Wide Web (WWW) and its communication conduit, the Internet, with its multimedia capabilities, interactive tools and telecommunication facilities, seems full of potential as a catalyst for significant and sustained CPD of geographically dispersed mathematics teachers. Accordingly, in recent years there has been a significant and continual increase in research efforts aimed at exploring the role and contribution of the WWW to all levels of education. One such research route focuses on the use of online discussion forums in an attempt to create virtual communities of practice wherein CPD can occur.

While pressing questions remains as to how online activities support quality and success in online endeavours (King 2002), there is little doubt that Internet technologies are a dominating force, and as such, are bound to transform traditional CPD models.

2. Problem identification

Schagler and Fusco (2003) reports that in education reform and teacher training projects, much time was dedicated to create and support sustainable and scalable online communities of education professionals. They note that for the most part, those communities have been created in isolation from the existing local professional communities within which the teachers practice and that professional development should be treated as a socio-organizational system. They warn that there are socio-cultural preconditions that needs to be considered to prevent “us from putting the cart before the horse” when developing online communities. (Barab 2003) supports their viewpoint by arguing that a “virtual community” must evolve with a group, around their particular needs, and for purposes that they value as meaningful.

Smiley and Conyers (1991), in reconceptualising CPD for teachers, called for a paradigm shift from learning separately and learning through replication (static learning) to learning together and practicing
reflection (interactive learning). As (Barnett 1998) notes, teachers are often isolated from one another and there is a need for them to engage in inquiry and reflection, a viewpoint supported by Clandinin and Connely (1995) and Stein, Smith and Silver (1999). Reflection, communication with colleagues and the exchange of knowledge and ideas is thus the conceptual backbone of this paradigm shift. In supporting this viewpoint, the Norms and Standards for Educators (Republic of South Africa Government Gazette, 2000) state that reflective competence is one of three strands of competence required of all teachers.

All the above viewpoints are particularly suited to an on-line discussion forum environment. However, South Africa is a country defined by diverse socio-cultural communities. In general terms, the white population group is recognized as (previously) advantaged, while the black population group is recognized as (previously) disadvantaged. Schagler and Fusco’s (2003) warning thus acquires added significance in this context, and the first question that arises is what personal and situational tensions exist within these diverse communities that would impact on the use of an online discussion forum in support of the CPD of mathematics teachers?

A corresponding issue but more specific to mathematics in an online context, is related to Internet failure to cater for spontaneous mathematical interaction. Thus far, authors have resorted to radical means to display mathematics on the Internet. For example, popular examples involve inserting images of equations into Web pages, and/or making electronic documents available for download in various formats, such as portable document format (pdf). Commercial software packages that make use of MathML (an XML application for describing mathematical notation and capturing both its structure and content) are available to ease the publication of mathematical symbols online. These packages share several shortcomings. Some of the more prominent limitations are: they are relatively expensive and each participant requires an installation; a relatively high degree of technical competence, advanced software and/or the support of technical staff is required before content can be published to the Web; the process is tedious and quick publishing is not possible; and none are supportive of interactive forum environments where mathematical content should be offered and responded to in real time. Here the Web functions as a distribution channel of static content while a response requires the reversal of above roles, typically on a separate Web space which offsets the perceived benefits of interactivity as offered by a forum environment. The basic premise advanced here is that some level of interactivity and productivity is lost if one cannot include mathematical expressions in your online interactions - if the need to do so exists. Therefore a need for a mathematics-friendly forum environment that explicitly supports the inclusion of mathematical symbols on demand exists.

2.1 Objective of the research

The objectives of our research were two-fold. The first objective was to develop an inexpensive and undemanding web-based Online Discussion Environment for Mathematics (ODEM) that will support and nurture spontaneous interaction between teachers, allowing them to include expressions if the need arises. Its contribution to the project lied exclusively in the structures it provided within which the main problem was studied, which is also the second objective.
The second objective was to separately provide the ODEM to two groups of advantaged and disadvantaged mathematics teachers in order to discover the personal and situational tensions that impacted on the use of the ODEM as a reflective tool in pursuit of CPD.

This paper reflects on the personal and situational tensions impacting on the use of a mathematics-friendly interactive online discussion forum environment as a reflective tool for the CPD of advantaged and disadvantaged mathematics teachers in South Africa.

3. Research design and methodology

3.1 Research approach

While the ODEM can be classified as an Information System (IS), the primary focus of the project was on discovering the personal and situation tensions that affected the use and value of an IS technology (the ODEM) in an educational process. The project positions itself primarily in the field of Technology Education.

In this project, context plays a major role. The goal of the project was to reflect on human actions that take place in the context-specific settings of advantaged and disadvantaged communities, and how their actions are influenced by their setting. Human activity should be studied in their real-life situation (Marshall and Rossman 2006), and this study therefore adopted the qualitative research paradigm.

Since the current study was aimed at producing an understanding of the context of implementation of an IS and the process whereby the use and value thereof was influenced by the context, a revelatory, interpretive and descriptive perspective was adopted as philosophical base.

As research approach, we used both grounded theory (GT) and activity theory (AT). The motivation is that GT is useful for deconstructing the raw data and AT is useful in focusing both the deconstruction and the analysis of data.

Annels (2006) notes that different research approaches can be creatively and successfully used in one project if there has been adequate consideration of vital factors that determine if there is a good ‘fit’ of the approaches, not only with the research problems and questions, but also with each other, while maintaining the integrity of each approach.

Whereas GT is a well-known and applied research approach, AT is a relative new concept and we therefore give some additional background on the underpinning theory of the approach.

Activity Theory

AT is particularly suited as a theoretical framework to follow when context is acknowledged. This study was underpinned by the philosophy that “participation in social organizations (e.g. families, communities, institutions or other informal collectives) provides for a complex set of interactions from which we cannot
extricate ourselves; we are simultaneously affected by our social environments while, at the same time, we participate in their creation“ (Little, McAllistair and Priber, 1997).

Leontiev (1981) states that attempts to correlate context and participants as interactants in communicative events (such as that which the ODEM offers) suggests the possibility of interpreting their interrelationship by applying the tri-stratal analysis of social activity. Figure 1.1 presents this tri-stratal framework.

**Figure 1.1 The tri-stratal framework of Activity Theory**

The three primary components of an Activity System (AS) are the subject, the object of the activity and the community in which they occur. For example, the *subject* is a mathematics teacher, the *object* is to participate in the ODEM and to build an online community, and the *community* is advantaged or disadvantaged. Each activity the teacher performs, for example participating in the ODEM, is analyzed as part of the collective and with a social-cultural context of the individual and the collective. A shared understanding of the character and history of the *subject*, the *object* which the individual is trying to reach, the characteristics of the *community* and the *tools* available to the *subject* is required if sense is to be made. Supporting components on the apexes of the triangle are the *rules*, the *tools* used, and the *division of labour* (roles). Here the *rules* were reflection and sharing with colleagues, the *tools* were an Internet ready computer with access provided from home, the *division of labour* was for teachers to post and respond to posts, and the *goal* was CPD. In the process of the object changing, all the other components adopt new perspectives, and a new Activity System is born. For example, if a computer experiences a hardware problem, the *goal* of the AS changes, as does the *rules* and the *division of labour*.

One of Engeström's (1987) original motivations for developing this model was to allow researchers to identify the inner contradictions that impose tensions on participants’ settings and help them change the nature
of an activity to overcome those tensions. A tension essentially brings instability to an Activity System. The identification of tensions therefore provides an indication of the stability of the Activity System. If there are no tensions, there are no contradictions and the nature of an activity does not have to change in order to overcome the contradictions, or to solve the tension for that matter.

3.2 Subjects

Ten disadvantaged teachers and ten advantaged and motivated mathematics teachers who regularly participate in Cluster meetings were identified by the Subject Advisor for the Gauteng North Area, and were invited to participate in the study. A total of 9 disadvantaged teachers (4 female and 3 male) and 7 advantaged teachers (6 female and 1 male) volunteered and were provided with home Internet-ready computers and 10 hours Internet access per month for a period of 4 and 5 months respectively in 2006. The advantaged group participated an extra month since their period included a traditional holiday month.

Both groups attended workshops before implementation where they were introduced to and trained in using the ODEM, and sensitized to reflective practices. The disadvantaged group was, with the exception of one teacher, PC-illiterate, while the advantaged group, with one exception, were PC-literate. All teachers taught at least grade 7 and taught in schools mirroring their level of advantageousness.

3.3 Data collection and analysis

Activity Theory techniques utilized lied exclusively in the discovery of Activity Systems that aimed to compartmentalize data decomposition and forming sensible units for analysis. Grounded Theory techniques employed focused on the decomposition of data collected from semi-structured interviews on completion of the project, server logs, our own and research diaries kept throughout the study, the posts made to the ODEM and a focus questionnaire, thereby providing multiple perspectives and ensuring triangulation of data (Glaser and Strauss 1967; Orlikowski 1993; Pandit 1996).

The analysis and reporting of data was pursued in the following order.

As a first step the interviews with the teachers, their research- and our own research diaries were open-coded in order to identify emerging concepts. These concepts were then grouped together in categories of best-fit. The categories that emerged were then used to identify sub-cases, or Activity Systems.

Secondly, each Activity System was then decomposed within its framework of subjects, rules, community, division of labour and the objects and goals. An attempt was made to interpret the collected data by identifying and describing the Activity System’s components and possible tensions that existed in and between components. Decomposition was a revelatory process – with each additional category decomposed, more insight was gained into previously decomposed categories. These insights forced us to regularly revisit the raw data in order to confirm and/or expand the growing “picture” that emerged. Thus, rather than following a step-wise
process, we adopted a cyclic process of open-coding, decomposition and axial coding. That is, as more and more categories were decomposed, more tensions surfaced which either explained or exaggerated previous tensions.

Thirdly, connections between categories and its concepts were integrated as part of the interpretation phase – bring meaning and coherence to the categories, developing linkages between tensions identified and making sense of the interview and journal data and the posts made to the ODEM. In a GT approach this process is known as axial coding. In this endeavour lied additional purposes of confirming existing or indentifying other tensions that may resolve of exaggerate the tensions already identified. Note that axial coding was not a third step as such, but attempted throughout the analysis as tensions emerged.

4. Perspectives of the Two Groups

In the following two sections, section 4.1 and 4.2 we report on the results found from the perspective of the disadvantaged group and the advantaged group.

4.1 Disadvantaged group

Two Activity Systems were identified for the disadvantaged group: DAS1: Connecting to the ODEM, and DAS2: Using the ODEM (DAS1 refers to Disadvantaged Activity System 1). Several tensions were associated with these Activity Systems. Consider Table 1.1 which groups the disadvantaged tensions identified according to Activity System components, whether they were ODEM- or non-ODEM-related, and whether they were personal, situational or shared.
Table 1.1 Disadvantaged Tensions of DAS1: Connecting to the ODEM and DAS2: Using the ODEM

<table>
<thead>
<tr>
<th>AS components</th>
<th>ODEM-related tensions</th>
<th>Non-ODEM-related tensions</th>
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<tr>
<td></td>
<td>Personal</td>
<td>Shared</td>
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<td>Rules</td>
<td>T1</td>
<td>DAS2: What to Post</td>
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<td></td>
<td>T2</td>
<td>DAS2: Irregular Contribution</td>
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<td></td>
<td>T8</td>
<td>DAS2: Quality of Participation</td>
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<td>Subjects</td>
<td>T3</td>
<td>DAS2: Lack of Fervour</td>
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<td></td>
<td>T4</td>
<td>DAS2: Lack of Reflective Practices</td>
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<td></td>
<td>T10</td>
<td>DAS2: Lack of Motivation</td>
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<td>Community</td>
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<td>Tools</td>
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**Key example:** T1|DAS2: What to Post refers to Tension 1 'What to post' identified from Disadvantaged Activity System 2.

The table shows DAS1 tensions to be situational, non-ODEM-related and limited to the tools and division of labour components, while DAS2 tensions were spread over AS components. The immediate impression gained is that disadvantaged teachers experienced a variety of tensions from various sources.
**T1|DAS1:** Creating Internet Accounts played a significant role in disrupting **DAS1:** Connecting to the ODEM, and resulted in the project being delayed for several months. This tension had several facets: the general unavailability of telephone lines for Internet connections and resultant difficulties in contacting teachers to install telephone lines, the role of Telkom as service provider and accounts creator, and the financial limitations of teachers. In essence, this tension existed because the community is disadvantaged. For disadvantaged teachers “getting online” from home is an arduous process that requires know-how, time, effort, support and cost.

**T2|DAS1:** Connection Problems, similar to **T1|DAS1:** Creating Internet Accounts exaggerated **T3|DAS1:** Lack of Suitable Support Structures. The focus here is not so much on the connection problems that were experienced since connection problems occur in all communities, but rather on the difficulty in providing support when connection problems did arise. These connection problems impacted on both **DAS1** and **DAS2**. If **T3|DAS1:** Lack of Suitable Support Structures can be resolved, **T2|DAS1:** Connection Problems will cause less imbalances in both Activity Systems, allowing teachers to focus on the goals of the Activity System.

**T3|DAS1:** Lack of Suitable Support Structures was exaggerated when teachers did not receive adequate support from the primary support agent which was Telkom. Here Telkom was an outside influence that became internal to the activity, and contributed to an imbalance in **DAS1**. When teachers experienced connection problems, they phoned Telkom for support as directed. In some instances the inability of the Telkom Call Center agents to provide support to PC-illiterate teachers forced us to adopt an unexpected and secondary support role. For example, when hardware problems surfaced, teachers had to make use of public transport to visit us at home after hours - which is difficult if one has to haul a PC-tower along in overcrowded minibuses. The absence of PC-companies in Townships exaggerates this tension.

The tensions of **DAS1:** Connecting to the ODEM thus all contributed towards the object of connecting to the Internet not being attained and the goal of participation in the ODEM not being realized for a long period of time. When **T1|DAS1:** Creating Internet Accounts was eventually resolved and teachers were in a position to connect to the ODEM, **T2|DAS1:** Connection Problems resurfaced for some teachers throughout the project.

The majority of **DAS2** tensions were associated with the rules and subjects (seven of the twelve tensions identified were associated with these two components, while the other five tensions identified were associated with three components). While it is tempting to conclude that the rules of **DAS2** did not suit the subjects, such a conclusion would be premature without a review of each tension.

**T1|DAS2:** What to Post is a complex tension which was not resolved within the time frame of the study. Data from attempts and nature of posts showed most teachers to have previewed their posts considerably more than what was eventually posted and that they were more inclined to respond to as opposed to starting a new thread. No posts contained any expressions, and in the absence of expressions (which requires a steeper learning curve than text-only posts) the excess previews generated implies that teachers were continually assessing the perceived value of their contributions. Several other tensions, notably **T3|DAS2:** Lack of Fervour, **T4|DAS2:**
Lack of Reflective Practices and T12|DAS2: Leader Required has the capacity to exaggerate this tension. Conversely, if tensions such as T9|DAS2: Training Required, T10|DAS2: Lack of Motivation and T12|DAS2: Subject Advisor Required can be resolved, they may (individually or collectively) resolve this tension. For example, having a knowledgeable Subject Advisor (in terms of understanding teacher needs) participating in the ODEM may well coerce teachers into regular contributions. The permutations between these tensions are endless. What endures is that T1|DAS2: What to Post exaggerated T8|DAS2: Quality of Participation.

T2|DAS2: Irregular Contributions was identified when it became apparent that, with the exception of two teachers, contributions were minimal even when most of DAS1’s tensions were resolved. All of DAS2’s tensions could have, collectively or in small parts, contributed to and/or exaggerated this tension. How it did would have depended on individual circumstances. For example, T8|DAS2: Quality of Participation was exaggerated for two teachers when other teachers’ responses to their posts were, according to them, unsatisfactory. For these other teachers, T1|DAS2: What to Post played an important role in T2|DAS2: Irregular Contributions being exaggerated. Likewise T7|DAS2: School/Township Related Issues may have played a significant collective or individual role in exaggerating T2|DAS2: Irregular Contributions. As with T1|DAS2 in the previous paragraph, if some or all of the tensions are resolved, they may contribute towards resolving this tension.

T3|DAS2: Lack of Fervour surfaced as a tension given the one-dimensionality of questions and responses. This tension could have had a potential snowballing effect on T8|DAS2: Quality of Participation where feeble questions spawned feeble replies. As with T2|DAS2, all the tensions identified from DAS2 could potentially have impacted on this particular tension, either in exaggerating or resolving it.

T4|DAS2: Lack of Reflective Practices was identified when the nature of the posts were investigated. A comparatively low percentage of posts contained evidence of reflective practices. In addition, teachers were somewhat divided on the value of the ODEM as a tool for reflective practices, preferring a content-driven approach. Some of the other tensions may have contributed to the lack of reflective practices. For example, not being able to resolve a content issue or a disciplinary problem may inhibit reflective practices by changing a teacher’s focus. Nonetheless, should one value reflection as a powerful tool in the CPD of teachers, the data shows the ODEM to not have nurtured reflective practices, although their efforts at reflective practices are noticed.

T5|DAS2: Financial Factors was identified as a tension because it impacted on both connecting to and using the ODEM. This tension was specific to many teachers not having an existing telephone line and to two teachers experiencing financial difficulties during the project. Not having telephone lines had a major impact on DAS1 and delayed the project substantially. Experiencing financial problems should not have affected the two teachers’ participation since participation did not cost them any money. However, the one teacher had his line disconnected while the other could not use the funds we paid into his account due to a debit balance. Although arbitrary incidences, they serve to illustrate the fragility of DAS2. With the exception of one teacher, none of the
teachers continued their Internet accounts on completion of the study, which raises questions on the sustainability of pursuing online CPD in disadvantaged communities, especially if one considers that very few of the teachers reported having access to school computer laboratories, with half preferring access from school even if access was available at home. **T5|DAS2:** Financial Factors also interacts with **T3|DAS1:** Lack of Suitable Support Structures in that there are costs involved in seeking and providing support. More often than not, we had to carry the costs of expensive cell phone calls to teachers in order to resolve their problems. When hardware problems (mainly related to PC-modems) surfaced, teachers also had pay for public transport in order to bring their PC-towers to us after hours.

**T6|DAS2:** A Busy Life is generic to a demanding family- and professional life, and impacted mainly on the time teachers had available to spent on the ODEM. Providing a specific packaged-Internet time period that they could connect to the ODEM had advantages in cost, but placed more demand on teachers thereby exaggerating this tension. There against, if the ODEM can replace cluster meetings, which demand a lot of travelling and thus time, time is saved. It could also be argued that by using the PC for administrative tasks (like some teachers did), more time is saved, although this would depend on their level of PC-literacy. This tension may well have contributed to or exaggerated **T2|DAS2:** Irregular Contributions, **T3|DAS2:** Lack of Fervour, **T8|DAS2:** Quality of Participation, **T11|DAS2:** Point of Access and **T10|DAS2:** Lack of Motivation.

**T7|DAS2:** School/Township Related Issues highlighted community-specific problems the disadvantaged teachers experienced. Disciplinary problems in school were highlighted as a major factor that affects the morale of teachers. High levels of crime in Townships resulted in upgraded computer laboratories being burgled overnight. One teacher was so badly affected by a criminal incident where guns were drawn that it left him unable to contribute to the ODEM for several weeks. The fact that teachers saw value in the ODEM as a communication line to a Subject Advisor indicates the need that these teachers have for support in a school system that some teachers perceived as “being in a mess”. It must be extremely challenging for teachers to commit to CPD opportunities when, seemingly, life is not mundane. This tension has the potential to contribute towards, or exaggerate **T10|DAS2:** Lack of Motivation.

**T8|DAS2:** Quality of Participation was identified when the value and depth of the interactions that took place in the ODEM were reviewed. Already referred to, this tension was specifically exaggerated by **T1|DAS2:** What to Post and **T3|DAS2:** Lack of Fervour. But other tensions from DAS2 may also have contributed to this tension in small parts. In fact, the intensity of this tension can be viewed as an indicator of the stability of DAS2. More importantly, the strength of this tension represents the final conclusion one can make on the value of the ODEM in the CPD of disadvantaged teachers. This tension arose because of other tensions, implying that those tensions must be resolved first before quality of participation will improve.

**T9|DAS2:** Training Required surfaced when it became apparent that teachers overestimated their level of PC-literacy. Despite the ease of use of the ODEM, two supporting workshops and a requirement that participants must be computer-literate, most teachers felt they required more training. Some doubt surfaced as to
the worth of their statements on training since these calls for more training may well have been used as a justification for poor participation rates. After all, if a teacher can make one post, then there is no reason they cannot post more – except if there are other tensions at play. The impression gained was that teachers required more training in how to use the ODEM more effectively than training in PC-literacy skills. This does not imply providing exact and/or regulatory pointers on what to post - it requires that teachers are nurtured, encouraged and reassured. A sympathetic Subject Advisor who can gently train (or elicit) reflective techniques may well resolve this tension.

**T10|DAS2: Lack of Motivation** refers partly to evidence that teachers may have enlisted in the study for the wrong reasons (obtaining a free computer and Internet access) and that this discord may have, contrary to expectations, impacted on their motivation to participate on a regular basis. While this tension potentially contributed to **T3|DAS2: Lack of Fervour**, **T1|DAS2: What to Post** and **T2|DAS2: Irregular Contributions**, it may equally be the product of other tensions or processes. For example, if a teacher does not receive useful responses to his posts, he may become demotivated.

**T11|DAS2: Point of Access** was a personal tension in some instances (one teacher accessed the ODEM from her parents home which required travelling to and from her own home while another was in the process of divorce) and situational in others (the lack of laboratories forced home access). **T6|DAS2: A Busy Life** could be resolved to some extent if teachers could access the ODEM when and where it suited them. However, we have already highlighted the fact that neither access from school laboratories nor home is presently viable for most teachers. This tension may have contributed to **T2|DAS2: Irregular Contributions**.

**T12|DAS2: Leader Required** was confirmed as a tension when it became apparent that teachers have a need for leadership within the ODEM and outside of the ODEM, with the ODEM serving as a convenient channel of communication. An obvious leader that could fulfil both roles would be the Subject Advisor. This advisor will need to stimulate discussion, to nurture, encourage and reassure teachers within the ODEM and provide support on issues outside the ODEM (e.g. disciplinary problems) which inhibit optimal participation in the ODEM. Thus she finds herself in a primary position to resolve most of the tensions of this group.

### 4.2 Advantaged group

Only one Activity System, **AAS1: Using the ODEM**, was identified for the advantaged group. Consider Table 1.2 which groups the tensions identified according to Activity System components, whether they were ODEM- or non-ODEM-related, and whether they were personal, situational or shared.

Table 1.2 shows the advantaged group to have experienced far fewer tensions than the disadvantaged group, with no tensions related to their community and only two tensions existing outside the rules and subjects.

<table>
<thead>
<tr>
<th>AS</th>
<th>ODEM-related tensions</th>
<th>Non-ODEM-related tensions</th>
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### Key example:

**T1|AAS1: Starting Threads** refers to Tension T1 ‘Starting Threads’ identified from Advantaged Activity System.

**T2|AAS1: Lack of Reflective Practices** was identified when it was discovered that despite teachers showing evidence of being accomplished reflective practitioners, a low percentage of posts were reflective in nature. Evidence from the nature of posts suggested that teachers have more practical needs they want fulfilled. In particular, and as the data analysis progressed, it became more and more apparent that teachers experience immense frustrations in their practice and that they have a far greater need for the ODEM to serve as a direct
channel of communication to a Subject Advisor who they perceive as being distant and ignorant to their problems.

**T3|AAS1:** *Slow Connections* was a source of frustrations for many teachers. The constant struggle teachers experienced making connections to the Internet in order to visit the ODEM exaggerated both **T4|AAS1:** *A Busy Life* and **T5|AAS1:** *Quality of participation*. The relatively low number of posts highlights the effect this tension may have had on the stability of the Activity System.

**T4|AAS1:** *A Busy Life* was the most pervasive tension impacting on the Activity System. Not having enough time impacted on the intention to contribute meaningful threads, or contributing to and/or exaggerating **T2|AAS1:** *Starting Threads*, which in turn contributed to and/or exaggerated **T5|AAS1:** *Quality of participation*. Some teachers connected on own cost at times outside the allotted Internet package time, indicating how powerful this tension was.

**T5|AAS1:** *Quality of participation* has already been linked to other tensions. The primary source of this tension may be that the needs of the teachers were not addressed. Two teachers suggested that they merely “went through the motions” in an effort to comply with the *rules* of the Activity System. This is not to suggest that teachers did not find value in the ODEM – most did – but merely that the *rules* of the current Activity System were not congruent to their immediate needs.

**T6|AAS1:** *Subject Advisor required* was identified when teachers’ real needs became apparent. These needs were mostly related to issues surrounding departmental policies and the need for Subject Advisors to act as a soundboard to their frustrations. It is reasonable to propose that if the *rules* of the Activity System were changed to “communicate with the Subject Advisor when needed and view Subject Advisor communications”, then all the tensions, except slow connections and a lack of reflective practices, will be resolved.

**T7|AAS1:** *Substance required* is closely related to **T5|AAS1:** *Quality of participation* in that one tension feeds of the other. If there is no quality of participation, there can be no substance, and vice-versa. This supports the notion that teachers’ real needs were not addressed by the current *rules* of the Activity System.

### 4.3 Core tensions

A dynamic interaction between all the existing tensions, individually and collectively, was evident. As these tensions become internal to the identified Activity Systems, some tensions had the ability to exaggerate other tensions, while other tensions, if resolved, has the potential to resolve other tensions. A question that remains is what the core tension(s) of each group were?

In the previous sections we adopted a vertical perspective in discussing the results. The majority of tensions (12 of the 22 tensions identified in **DAS1**, **DAS2** and **AAS1**) were found along the Personal|*Subjects* and Personal|*Rules* intersections. This finding indicates that the *rules* of the current Activity Systems (reflecting on and sharing their practice) did not fit the current *subjects*, resulting in several personal and situational,
ODEM- and non-ODEM-related tensions surfacing that impacted on the object of participation and community building.

However, from a horizontal perspective, it becomes evident that tensions to the right in Tables 1 and 2 exaggerate tensions to the left. Consider the disadvantaged ODEM-related tensions presented in Table 1. If T12|DAS2: Leader Required is resolved through an active leader who provides training, guidance, encouragement and support via the ODEM, then T1|DAS2: What to Post, T2|DAS2: Irregular Contributions and T8|DAS2: Quality of Participation will be largely resolved. Similarly, on the non-ODEM side of the table, if all schools have safe and functioning computer laboratories from where teachers can access the ODEM, T5|DAS2: Financial Factors would be less pervasive, as would T6|DAS2: A Busy Life since teachers can access the ODEM in their free periods or when it suits them. T11|DAS2: Point of Access is also largely resolved since teachers will have reliable access.

It thus appears if situational tensions form the core tensions of the disadvantaged group, that is, T12|DAS2: Leader Required and T7|DAS2: School/Township Related Issues. A similar approach to Table 2 shows T6|AAS1: Subject Advisor required to be the core tension for the advantaged group.

That these are the core tensions confirms some of the findings. That is, the exact role the Subject Advisor will play within each group is very different because of the variety of tensions - the main notable variation being that the disadvantaged group requires macro leadership to solve their diverse tensions within and outside the ODEM, whereas the advantaged group merely requires the participation of a Subject Advisor - most notably as a soundboard for their frustrations experienced outside the ODEM.

5. Contribution

 Having developed a mathematics friendly forum environment for mathematics, we investigated and identified several personal and situational tensions that impacted on the use thereof as a reflective tool for the CPD of disadvantaged and advantaged teachers.

A review of the tensions indentified has led us to the following preliminary contributions:

- Participation by mathematics teachers in an online forum in pursuit of the CPD is influenced by forum- and non-forum-related tensions, the sources thereof either personal or situational. Situational tensions result in many of the personal tensions found. The impact of these tensions has the ability to destabilize an online forum and prevent the goal of CPD from being reached.

- Disadvantaged teachers generally face more tensions than advantaged teachers. Since these tensions have different sources and impact at different levels, the rules, the object and the goal of the forum should be specific to communities.
Forum tensions are closely associated with the real needs of teachers. If these needs are not resolved, tensions results.

A Subject Advisor is best positioned to fulfil these forum needs by selecting an appropriate online CPD strategy given the tensions that exists.

Whereas the ODEM can be a useful tool, a mathematics-friendly forum environment is not a current need.

### 3.7 Conclusion

The objectives of this research were firstly to develop an inexpensive and undemanding web-based Online Discussion Environment for Mathematics (ODEM). Such an environment was successfully developed to explore the second objective, which was to separately provide the ODEM to two groups of advantaged and disadvantaged mathematics teachers in order to discover the personal and situational tensions that impacted on the use of the ODEM as a reflective tool in pursuit of CPD.

An in-depth case study research was done where teachers from both the disadvantaged and advantaged groups were monitored and interviewed on the adoption and use of the ODEM system. The tensions found in the report back period were analysed and the researchers found that there are several tensions that prohibited the users from using the environment, not necessarily related to the environment itself.

For further research, the study should be repeated with larger groups but leadership should be originated from within the educational system itself to motivate participation.

This research gives once again emphasize that financial support for any new innovation are not necessarily enough motivation, but that leaders will have to be innovative in establishing new technologies.
References


