# COMPUTING AT SCHOOL: AN EMERGENT COMMUNITY OF PRACTICE FOR A RE-EMERGENT SUBJECT

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## Abstract

The Computing at School (CAS) working group was formed in 2009 as a grassroots organisation with members drawn from schools, higher education and the computing industry. Their concern was the drop in applications for undergraduate computing courses and a dearth of specialists entering related professions. This paper studies the development of the organisation with respect to models of communities of practice. The methodology is a retrospective reflexive study based analysis of e-mail transactions to review the association's activities and relationships with other stakeholders in computing education. Through this, the formation of a new professional community of practice is tracked and its characteristics established.

## Introduction

This paper reports on the emergence of Computing at School (CAS). This group brings teachers in schools, colleges and universities together with representatives from industry who work together to support the teaching of computing up to age 18 and to facilitate university entrance in this subject. The paper reflects on the development of the CAS organisation and the growth of a de facto community of practice (CoP). This is encapsulated in the transactions of its members and the establishment of a body that is now influencing the very context and political landscape in which it is developing.

The paper's authors are themselves members of the association and so this account is both reflexive and semi-ethnographic. It is a study of the community in which the writers are themselves located, its position in relation to other communities, stakeholders and policy makers. We acknowledge that our stance and findings are biased by our involvement but seek to reflect on the conditions that enabled members of the association to coalesce around common concerns and objectives, the ways in which this might be represented as a model of a CoP and the impact that has had on the external context in which the association operates – namely the subject of computing in schools.

The paper addresses two questions. Firstly, and setting a theoretical frame we establish what we mean by communities of practice and how they are supported by online technologies. This is our theoretical frame. The importance of technology is included here as it is through the medium of digital communications that the overwhelming majority of transactions take

place. This is a technologically enabled community. Without the technology, we argue, the community would be very different and the association's emergence would have taken a very different trajectory. The second is our research question, which we answer through empirical enquiry – "What are the characteristics of CAS as a community of practice?"

## Context

CAS emerged in 2008 as a response by a collective of individuals concerned with the decline in admissions to undergraduate computing programmes in the UK (Fowler & Yamada-F, 2009; UCAS, 2011; see also Becerra-Fernandez et al., (2010) for a discussion of a parallel situation in the USA). The decline was combined with a shortfall in professionals entering the industry with the Council of Professors and Heads of Computing forecasting a shortfall of over 30,000 computing graduates by 2016 compared to the number of vacancies in the market (CPHC, 2008; see also E-skills, 2008). The two figures are, of course, related: fewer students entering computing programmes result in fewer entering the job market. The embryonic association consisted of academics from university computing departments, schoolteachers (and those in county-level support roles), representatives of industry and the BCS - formerly known as The British Computer Society and the UK's Chartered Institute for IT. These constituencies, and their relative significance, will be discussed later as components of the community. They also provide the sample for key informants in the evidence relating to the formation of a CoP.

The major concern in the response of the individuals who formed CAS was the position of the subject of computing in schools and the qualifications offered to students prior to higher education. They are, self-evidently, major contributors to the level of undergraduate admissions. Less obvious is the impact of the attitudes of universities to such qualifications.

In England, Wales and Northern Ireland the standard school leaving qualification is the General Certificate of Education, Advanced Level. In Scotland, students take Higher and Advanced Highers. The abbreviation A-level will be used to represent all of these qualifications. If computing is not offered at A-level in schools one might expect that fewer students would apply to study it at university. This relationship is complicated by the fact that for first degrees in computing UK higher education does not require any formal school qualification in the subject (Clark & Boyle, 2006). Often admissions criteria stress the importance of mathematics or physics whereas computing or computer science is, at best, an option. While the decline in admissions to university computing courses commenced in the late 1990s and has continued over the first decade of the 21st century (CHPC, 2008; UCAS, 2011), the position of school-level computing as a non-mandatory entry requirement has persisted throughout this time. Why should there be concern about the subject in schools in 2009 when it had not been an essential pre-requisite during a period of increasing admissions up to the early 1990s?

Computing has a long history in UK schools. From the 1970s qualifications were available in the subject for students aged 16 and 18. In 1988, however, the National Curriculum for England Wales introduced Information

Technology. At first subsumed into the Technology curriculum IT, later ICT, became a subject in its own right in future revisions. By the time the curriculum was redrawn in 1999 it had become manifest as a subject with both general and vocationally related qualifications and as a key skill. It had become all-pervasive in the landscape of qualifications while its 'older relation' – computing – had started to decline.

ICT's position had burgeoned, and was bolstered by its representation in performance tables for English schools where it could count for up to four times other subjects (Mansell, 2007). With this possibility, schools focused on ICT to 'bolster' (ibid.) their performance – crucial in gaining reputation and good inspection reports. Specialist teaching had become diverted onto ICT and computing withered. There was a decline in entries for computing in schools, mirroring that in higher education. University teachers of computing and their counterparts in schools shared the same concern of falling numbers of specialist students. It was at this point that the original members of CAS came together to discuss what might be done. Shortly afterwards, in 2010, a new government in the UK embarked upon a radical education agenda openly driven by the financial climate and a reduction in central provision of services. Bodies that had previously supported ICT in schools – noticeably the national agency (Becta) and local authorities – were either abolished or reduced in importance. Performance tables were readjusted so that ICT could not count as four subjects and, perhaps most significant of all, a review of the National Curriculum in England was announced with the emerging recommendation that ICT be downgraded to a basic subject. Thus CAS was born at a time when the status quo for ICT in schools was about to be disrupted.

## Communities of Practice and Online Technologies

Etienne Wenger describes CoPs as groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. (Lave & Wenger, 1991; Wenger, 1998, 2006). Related to this notion of social learning is the theory of social constructivism. Here engagement in learning comes through activity and communication. Collaboration and cooperative activities support learning and develop socially constructed ideas and understanding. In online contexts, learning and the development of communities of practice in online contexts mirrors that in socially constructed learning in traditional contexts.

For Wenger (1998, 2006) there are three elements to a CoP:

- **Domain**. All members of a CoP work in a context that is coherent.
- **Community**. Members of a CoP work together, learn together, develop common solutions and induct new members (see especially Lave & Wenger, op.cit., on this last point).
- **Practice**. Members of a CoP carry out similar tasks and activities. These situate the learning and help to define and develop the domain.

In all of the above there is an implicit need for communication. In the early CoPs studied by Lave and Wenger, op.cit., the dominant form was of working

alongside a mentor in an apprenticeship model. One learnt from those around and was inducted into the community through shared practice. Once inducted, new members moved from the periphery to the centre of the community and became fully engaged in its collaborative efforts.

Wenger's practice and community are given greater texture by Schlager and Fusco (2010), who describe a number of 'guideposts' relating to communities of practice. Here six key aspects emerge:

- **Environment.** A community of practice is a learning environment based upon social activities with social roles reflecting competence and experience.
- **History.** A community of practice can emerge from traditional activities and the norms and practices are inherited from the previous engagements.
- **Membership roles**. The membership of a community is not uniform or static. There will be a range of people with different competencies, knowledge, interests and motivations.
- **Membership growth**. The community continues to grow over time.
- **Networking.** A community of practice is a social network with exchanges evidenced in discussion and production of shared knowledge.
- **Outcomes.** The activities of a community of practice are most frequently recorded and archived within the technology. However, the outcomes are less tangible, perhaps more decisive and certainly most important to the wider world. A measure of the impact of a community of practice is not limited to the electronic record of the exchanges but is measured by the changed actions and attitudes of the participants and the influences upon those outside of the community.

This framework is used below to analyse the transactions of CAS members. Significantly though, these transactions and the existence of the organization are mediated through the use of technology.

The understanding of the value of technology for such communication and collaboration started to emerge in the late 1990s with the widespread access to Internet-connected computers. Computer-mediated activities in education became more collaborative, interactive, shared, focused and analyzed. CoPs developed models of working together online (Conole, 2007; Conole & Oliver, 2007; Laurillard, 2002; Salmon, 2000; Somekh, 2007; Wenger et al., 2002; Wenger et al., 2009). Concomitantly, the agenda of online learning moved towards a social dimension. Learning together did not mean working together in the same physical or temporal space but working with increasingly sophisticated tools to develop practice within the community's domain.

Technology is significant in the consideration of CAS as a CoP as its members are distributed across a country and rely primarily on technology for communication and sharing of practice. In some ways the association exists in the online transactions of its members – e-mails and videoconferences. These are supported by face-to-face meetings: a national conference, local hub

meetings and termly working members meetings, but, in respect of establishing the organization, these have been overshadowed by electronic interactions.

## Empirical Research

Having discussed the context for the emergence of CAS and the theoretical framework for communities of practice we now turn to the empirical research that allowed this emergence to be analysed.

### Methodology and Methods

The methodological approach is that of a reflexive ethnographic study. The researchers are part of the context being studied. This approach is variously known as traditional auto-ethnography (Hayano, 1979), insider-ethnography (Brannick & Coghlan, 2001) or self-ethnography (Alvesson, 2003). The study cannot be purely ethnographic because of the subjectivity of the writers – they are to an extent participants as well as observers. Both are closely engaged in the development of CAS. Ethnographic studies traditionally combine observation, interview and documentary analysis (Hammersley & Atkinson, 2007). The writers' own involvement in the communities makes observation more problematic as it is coloured by their own position. To minimise the bias associated with this, a large data set was collected from online and other transactions between members of the community. Through this, the research question,"What are the characteristics of CAS as a community of practice?" was addressed.

The online transactions are represented by the e-mail exchanges in the group. These were analyzed for volume, membership and topics. The last of these were mapped against the frames of Wenger (1998, 2006) and Schlager & Fusco (2010), which were used to analyse the data collected. This 'tells the story' (Hammersley, 1990) of the emergence of CAS and the extent to which it may be considered a CoP.

### Analysis of Transactions

CAS formed in 2008 through discussion between individuals in industry, schools and universities with the initial discussions taking place at Microsoft in Cambridge. The very first e-mail to the membership of the CAS (sent at the start of February 2008) identifies members as 22 people – four of whom worked in the computing industry (representing three companies) plus two at the BCS, six in higher education, seven in schools, two for an awarding body (responsible for examinations in schools) and one for a local authority (responsible for supporting and developing the curriculum in schools).

This initial bias, in which those working in schools were in a minority continued through the first year of the group's existence. During this time there was no external presence to the group. Work was going on behind the scenes to establish it.

The first announcements of CAS's existence were made during the academic year 2009/10. The community moved from being a 'secret' work in progress

to one that was starting to organise its first events. These included local 'hub' meetings and other professional development (PD) activities. A partnership was agreed with the Vital programme for professional development (see Bradshaw, Twining and Walsh (2011; 2012) whose platform carried online 'Teachshare' seminars. PD events were also run by university members of the CAS group and others held in association with an awarding body. This growth in activity was accompanied by a growth in membership as shown in Table 1.

Table 1

*Membership of CAS by Sector from Its Formation*

| | Members | Schools | | Industry | | Higher Ed | |
|---|---|---|---|---|---|---|---|
| March 2008 | 22 | 7 | 32% | 6 | 27% | 6 | 27% |
| March 2009 | 34 | 12 | 35% | 8 | 24% | 10 | 29% |
| March 2010 | 220 | 145 | 66% | 19 | 9% | 43 | 20% |
| March 2011 | 549 | 422 | 77% | 36 | 7% | 67 | 12% |
| Feb 2012 | 1165 | 905 | 78% | 96 | 8% | 118 | 10% |

Noticeable trends in this membership data are the steady increase in proportion of schoolteachers as members. The group was established to help teachers implement and develop computing courses in school. Teachers responded by joining the group – theirs is the core constituency and computing in schools the core focus for activities.

The membership process is that individuals request to join and then an invite is sent from the group's co-ordinator. For the first two months of 2012 some 454 people have asked to join the group although only 223 have accepted invitations at the time of writing this paper. From January 2012, a new online membership form was launched with greater profiling of members. This gives more information about the type of work a member does. Table 1 was compiled from only those accepting invites and the job type was based on limited information – e-mail and work addresses where given. Table 2 considers all those who have asked to join (N=454) and takes data from their profiles. There would appear to have been a sudden upswing in interest in the group from IT professionals - 81 applications have been received. This has only resulted in 16 conversions to membership however. This may again reflect the fact that core transactions of the group are focused on schools.

Table 2

*Membership of CAS – Requests to Join 2012*

| Schools | Industry | Higher Ed |
|---|---|---|
| 58% | 18% | 12% |

The manifestation of these transactions is the e-mail traffic that is associated with the CAS group. There are three mailing lists operated by the group – the main 'list' for all members; a list for those who sign up as 'working members' and attend termly meetings to steer the group; and a list for the 'board' a smaller group that represented the different constituencies and sponsors. The analysis here is of the main list. This is for two reasons. Firstly, the output from the decisions of the other two bodies makes its way to the whole membership; and secondly, it is the group as a whole that is being analysed for features of a community of practice.

Since February 2008 when the group was established, and until 15 February 2012, some 7213 e-mails had been sent to the list. These were analysed by type at different points in the group's development as shown in Table 3. The data shows that there was a flurry of activity when CAS was first mooted in the spring of 2008. Discussion at that time centred on the organisation and name of the group. This was accompanied by internal debate as to the nature of the curriculum and issues in schools and industry. A 'Book of Knowledge' (BOK) was proposed and started, which encapsulated the group's view of the computing curriculum. There was relatively little sharing of resources at this early stage. By the end of 2008 the group's discussions had virtually ceased. The activity was centred 'off stage' with the development of a website, writing of the BOK and establishing of sponsorship. There was little engagement by members in e-mail discussion.

By the end of 2009 the group was beginning to gather momentum as its membership slowly grew. A conference had been held in the summer. A newsletter and Twitter account were added at this time to increase the CAS's visibility. There was still much discussion about the way in which the group should be structured but this was now complemented by members sharing resources and ideas for continuing professional development (CPD) provided by others. The industry focus had dropped and the majority of the discussion of issues related to those in schools. Interest in qualifications had developed with the launch of the first of the GCSE Computing specifications. At this point its development CAS was beginning to be asked to provide CPD. The BOK was launched and the first local hubs held – face-to-face meetings in regional venues, organised by members and a presence at the annual BETT show in London that showcases technology in learning. The group discussed whether it was ready to become a formal subject association (this has not yet happened).

By November 2010 the group's processes had been established and discussion on internal issues was largely absent from the e-mails. There was again, as at the very start, a renewed interest in defining what computing is as a subject

and presenting a public face. Media contacts were become more frequent with evidence of television, radio and press approaching CAS for comment. Alongside this were the beginnings of its assertion as an influencer with both proactive and reactive engagement with policy makers. The website underwent a transformation and a previously public wiki was removed. In January 2011, the first online CPD events were held enabling the professional development provided by the group to reach wider audiences.

By the beginning of 2012 CAS had over 1000 members and e-mail traffic had tripled year on year. There were a plethora of policy changes at this time and CAS was again influential in them and its members were very active in discussing them. Policies and reports, hardly commented on just a year earlier were now a significant debating point for the membership. CAS had moved from a small group of interested individuals just four years earlier to being centre stage as the curriculum in ICT and computing was being dismantled and reviewed.

Table 3.

*Analysis of E-mail Transactions in CAS in Five Quarters*

| | | 02/2008-05/2008 | 11/2008-01/2009 | 11/2009-01/2010 | 11/2010-01/2011 | 11/2011-01/2012 |
|---|---|---|---|---|---|---|
| Total messages | | 337 | 9 | 354 | 532 | 1673 |
| Total threads | | 66 | 6 | 79 | 153 | 361 |
| CAS management | Agenda and actions from meeting | 61 | 2 | 7 | 17 | 3 |
| | Discussing name | 48 | | 0 | 0 | 0 |
| | Models of organisation | 66 | | 58 | 19 | 8 |
| Defining the subjects of computing and ICT | General | 43 | | 6 | 94 | 297 |
| | Developing a Book of Knowledge | 23 | | 0 | 8 | 5 |
| | Discussing qualifications | 2 | | 21 | 23 | 69 |
| Discussing issues | In industry | 31 | 2 | 0 | 4 | 6 |
| | In higher ed. | 8 | | 1 | 2 | 18 |
| | In schools | 26 | 4 | 76 | 61 | 238 |
| | In policies and other reports | 4 | | 0 | 53 | 276 |
| Policy | Seeking to influence policy/meeting with others | 8 | | 5 | 12 | 149 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sharing and discussing | Resources for computing | 9 | | 98 | 161 | 366 |
| | Media links about computing | 4 | 1 | 4 | 20 | 25 |
| Other | Miscellaneous | 3 | | 3 | 7 | 36 |
| CPD | Internal | | | | 16 | 57 |
| | External | | | 37 | 15 | 49 |
| Social | Intros | | | 19 | 20 | 71 |

## Discussion

The research was undertaken to address the research question "What are the characteristics of CAS as a community of practice?" This is now examined in the light of the frames of Wenger (1998, 2006) and Schlager and Fusco (2010). Wenger (1998, 2006) establishes that a CoP exists where its members share three attributes – domain, community and practice. The common concerns of CAS's members are the curriculum of computing and its relationship to wider learning. This shared domain also includes the aspects of assessment at school leaving age and subsequent entry into undergraduate programmes. That CAS members share a common domain is axiomatically true. It is seen particularly in the number transactions on the development of the BOK and on the definition of curriculum and qualifications. Together these account for 1225 of the 2905 e-mails analysed or 42% of the sample.

The CAS organisation was established by a group of individuals who shared the common concerns above. This group has grown to over 1000 by the end of 2011 but the essential domain is unaltered. This growth shows both aspects in the model of Schlager and Fusco (2010) – membership growth and roles. The latter is rather flat, as the group has no committee or officers other than one person working for it in a part time capacity. Rather, the roles emerge in response to specific tasks, with 90 e-mails identifying and following up actions from meetings. While this only accounts for 3% of the total, this rather low figure is because such e-mails did not generate much discussion.

Community is evident here and is underlined by the extent to which there is shared learning, exchange of ideas and development of a unified 'presence' that defines the organization as more than a group of loosely connected individuals. Members turn to the list to share resources for teaching (21% of e-mails), to discuss issues they face in schools (8%), to debate policy changes (10%) and to set the agenda for the development of the group (9%) and the curriculum of computing (15%). Here too is Schlager and Fusco's model's history element with the change from internal organizational factors dominant in 2008 to external policy influence in 2011. This last aspect also resonates to some extent with the outcomes aspect of this model as the group produces policy papers and responses to consultations. Aspects of community are also noticeable by the common practice of introducing oneself as a new member and the regular asking for help that is met by the sharing of resources.

Wenger's third criterion for a CoP is that of shared practice. The overwhelming majority (more than 85%) of CAS members are schoolteachers. Many of the rest are teachers in universities; others work in the computing industry but are involved in educational aspects therein. The membership's shared practice is that of developing computing knowledge, understanding and skills in young people. As a consequence of this endeavour, the organization is also engaged in promoting opportunities for such activities to flourish in schools. Thus it is concerned with review of curriculum and assessment so that computing can take its place alongside other school subjects. The empirical part of this paper gives numerous examples of this shared practice. In the e-mail discussions members share their practice through discussions about issues faced in school, to examples of CPD activities and the sharing of resources to help with teaching and learning.

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