

# Barriers Inhibiting the Development of a Self-Sustaining Virtual Learning Cluster of Schools in New Zealand: The case of the C-Net cluster

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## Abstract

Secondary school students and teachers located in remote areas are faced with barriers to educational access not seen in denser population areas. Students have the problem of accessing teachers of specialised subjects and access to the curriculum options their urban counterparts enjoy. In turn, teachers in remote locations have limited opportunities for professional learning and development, particularly for integration of ICTs into their classroom practices. Virtual clustering of local, small, rural schools using video conferencing and collaborative networks is one of the approaches adopted by some schools to overcome the barriers. Although the use of ICT for forming a collaborative cluster seems a good strategy, self-sustainability of the clusters initiated and led by the community of schools from the grass-roots level remains a problem and has generated potential for a knowledge gap.

This qualitative case study research intended to identify the inhibiting factors that challenged the development of C-Net as a self-sustaining Learning Exchange cluster in New Zealand. The process of Translation from Actor-Network Theory has been used to report the findings.

**Keywords:** Actor-Network Theory, Grass-roots Level Initiative, ICT4D, Learning Exchange, Virtual School Cluster, Self-Sustainability, Qualitative Research

## 1 Introduction

This paper reports the research findings of a case we refer to as the C-Net<sup>1</sup> secondary school cluster participating in the Learning Exchange programme in New Zealand. The Learning Exchange is a virtual collaboration built on video conferencing and collaborative technologies used between groups of schools mainly from the same geographical region. The clusters offer reciprocal, online, synchronous classes for their students in subjects that are otherwise unavailable at their own schools, and offer professional learning and development (PLD) opportunities for teachers. First, interested schools form a virtual cluster and then offer to teach each other's students in the subjects that are not available at their local schools. Videoconference (VC) and (more recently) Google classroom, Google site, Google hangout and other tools are utilised to form an online class and teach the required subjects regularly, for an hour once a week throughout the whole school year. The VC-based exchange setup is also used for the provision of PLD opportunities for their teaching staff.

A-Net<sup>2</sup> (another pseudonym) is the school cluster who pioneered the Learning Exchange programme. Since its inception around 2001-02, the Learning Exchange model has been adopted by a number of regional school clusters from across New Zealand. However, only half of the clusters have become self-sustaining clusters and others have disappeared. This research aimed to address the problem of cluster self-sustainability. The research examined the case of C-Net which was initiated around 2002-03 and started to disintegrate from 2010. The selection rationale was to identify the factors that inhibited C-Net from becoming a self-sustaining group and thus address the research problem of why some of the Learning Exchange clusters could not become self-sustainable.

The case study addressed two research questions: how was the C-Net developed as a Learning Exchange school cluster? And, what were the factors that inhibited C-Net from becoming a self-sustainable school cluster? A qualitative case study method was adopted for the study and Actor-Network Theory or ANT was used as a theoretical lens for the analysis of the collected data. With the utilisation of the process of Translation from ANT in Section 4, this paper reports C-Net's development from 2002 to 2010 and thus answers the first question. That is followed by the Discussion Section, which analyses the key findings in order to identify the disruptive factors that led the C-Net leaders to dismantle the cluster.

## 2 An Overview of Relevant Literature

The following review of relevant literature discusses: firstly, the distance education and the learning exchange concept, next, the context of ICTs and virtual collaborative learning, followed by a discussion of changing paradigms of learning and schools community developmental approaches and self-sustainability.

### 2.1 Distance Education and the Learning Exchange

Because of the geographical isolation and limited resources, small schools in rural areas are faced with challenges in the provision of education. The barriers prevent the school leaders from providing a similar range of curriculum choices to their secondary or high school students compared to those which are available to students at larger, city schools (Barbour & Wenmoth 2013). Historically as well as presently, the Correspondence School (TCS) has been used as a method of distance education for addressing the shortcomings surrounding rural schools (Moore & Kearsley 2011). Although computer-mediated, digitised versions of the TCS delivery model are available, there has traditionally been some dissatisfaction with them, particularly amongst school students. Examples of unpopular factors include: the absence of a real person, such as a teacher and fellow students during TCS activities, a minimal level of engagement among fellow students, the absence of competition amongst students, and the lack of collaborative and synchronous learning (Ali, Yoong, & Sylvester, 2016). In the New Zealand context, some affected schools in rural Otago and Canterbury (two regions of New Zealand) responded to the situation by initiating an alternate solution around 2001, which is known as the Learning Exchange as well as the Virtual Learning Network (VLN) (Pullar & Brennan 2008). Our findings elaborate on this important topic.

### 2.2 ICTs and Virtual Collaborative Learning

More recently, various innovative ICT-based media and tools are being used as mediators, giving distance educators and learners efficient communication and collaboration (Veletsianos 2010). Some

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<sup>1</sup> C-Net is a pseudonym used to refer to the case and adhere to the research's human ethics agreement.

<sup>2</sup> In earlier publication, Ali, Yoong, & Sylvester (2016), A-Net has been referred to as SchoolNet.

tools are more appropriate for synchronous activities while some are a better fit for asynchronous tasks, augmenting one another (Anderson & Simpson 2012). Videoconference (VC) is one of the communication media with higher synchronicity, facilitating participants to converge over a common understanding (Dennis et al. 2008). Smyth (2005) and Greenberg (2004) agree with the effectiveness of VC for collaborative learning, albeit for a small group of participants.

Similarly, the notion of school clusters can be related to the concept of clusters proposed by Michael Porter in 1990. Porter (1998) regards clusters as the geographic concentrations of interconnected groups of organisations from a particular field. Although members of a cluster are nominally competitors, they form their group to improve their overall performance, particularly for gaining economic benefit (Kuah 2002). The strategy indicates that collaboration can exist even between local competitors for gaining economies of scale and competing with non-local or global competitors. Although schools in the Learning Exchange also form regional clusters, the collaboration via clustering is virtual instead of physical.

### **2.3 Changing Paradigms of Learning and Schools**

Literature reports the re-conceptualisation of learning and the concept of a school, and the changing roles of learners and teachers. With the shifting of educational paradigms, educators are focusing more on the social or collaborative style in which learners construct their own knowledge through the social process (Nilsen & Puro 2005). The Learning Exchange and the cluster model relate to the proposed changes. Such as, the exchange of resources through collaborative learning suggests that the teaching and learning focus cannot be restricted to individuals and confined spaces (Barbour & Wenmoth 2013). Teaching and learning can instead take place at any time and at any place if different aspects of schools/education processes are interconnected in a network – known as the ‘Networked School’.

### **2.4 Community Developmental Approaches and Self-Sustainability**

Two main approaches can be discerned in the ICT-based community initiatives: bottom-up and top-down developmental approaches. Initiatives taken by community groups follow a bottom-up developmental approach. Such initiatives are from grass-roots level, organic and self-reliant in nature with a sense of community ownership (Gurstein 2007). On the other hand, initiatives by governments and business organisations from outside the community follow a top-down developmental approach, in which the relationship is more service-client in nature (Ali, Yoong, & Sylvester 2016). Although the bottom-up developmental approach seems to be authentic from the ICT for Development (ICT4D) and Community Informatics perspectives (Gurstein 2007), resourcing and self-sustainability are two of the common issues disrupting the initiatives (Ali, Yoong, & Sylvester 2016). Some studies, such as those by Bolstad and Lin (2009), Davis et al. (2007) and Powell (2011), have examined the Learning Exchange; however, they have not addressed the issue of cluster self-sustainability. For example, Powell (2011) briefly mentions some clusters that have easily adjusted to the Learning Exchange while others are struggling. However, the study does not identify any reasons for the problem addressed by this study.

## **3 Research Design and the Theoretical Lens**

This case study follows a qualitative research methodology with an interpretive approach. Due to insufficient knowledge about the C-Net case, the adoption of the case study method allows the researcher to focus and include all aspects of the cluster. The key objective of this study was to identify the barriers hindering the self-sustainability of a Learning Exchange cluster. Since C-Net has stopped working as a virtual collaborative learning cluster of schools, the selection of C-Net remained very relevant. In-depth individual interviews were conducted with a number of individuals from the Learning Exchange and the C-Net cluster. NVivo software was used for organising and reducing interview data into meaningful chunks represented by nodes. The nodes were further reduced into inhibiting factors or barriers.

Actor-Network Theory (ANT) was used as a theoretical lens. The theory views society or social groups as networks of heterogeneous elements, both human and non-human, called ‘actants’ (Callon 1986; Latour 1986; Law 1992). In the networks, all the actants play their roles in the building and stabilisation of the networks. In line with that socio-technical foundation, inputs from non-human actants were also gathered. Specifically, as suggested by Vos (2014) and others, data about non-human actants, such as schools as organisational actants and VC as technological actants, were collected from their agents. For example, e-teachers were questioned not only regarding their individual roles but also about their interactions with ‘the things’, such as ICTs. That was to identify whether ‘the things’ were being used effectively. In addition, relevant documents were gathered in order to find out more about the roles of the things in the making and stabilisation of the network. For example, cluster reports, memoranda of

understanding (MOU) between the schools, and documents from MOE and other sources were gathered. Those ‘inscriptions’ were un-boxed, analysed and included in our findings.

Although ANT with its three key concepts of heterogeneity, generalised symmetry and agnosticism guided us during the data collection process, the primary use of ANT was to provide a theoretical basis for reporting the findings. The four phases of Translation from ANT (see Figure 1) have been used to outline the findings. Regarding the findings’ credibility, a summary of the findings was posted to the research participants for their review and confirmation. In most cases, they agreed with the findings and suggested some minor editing which has been addressed. Prior to that, the audio-recorded interviews were fully transcribed and sent back to participants for them to check whether the transcriptions correctly represented their views, and thus establish the findings’ credibility.

## 4 Key Findings

The following Figure 1 (adopted from, Ali, Yoong, & Sylvester, 2016) illustrates the four phases of Translation and the relevant activities during each of the phases. Those activities also give some brief description of what each of the phases mean (for further explanation, please see Appendix 1.)

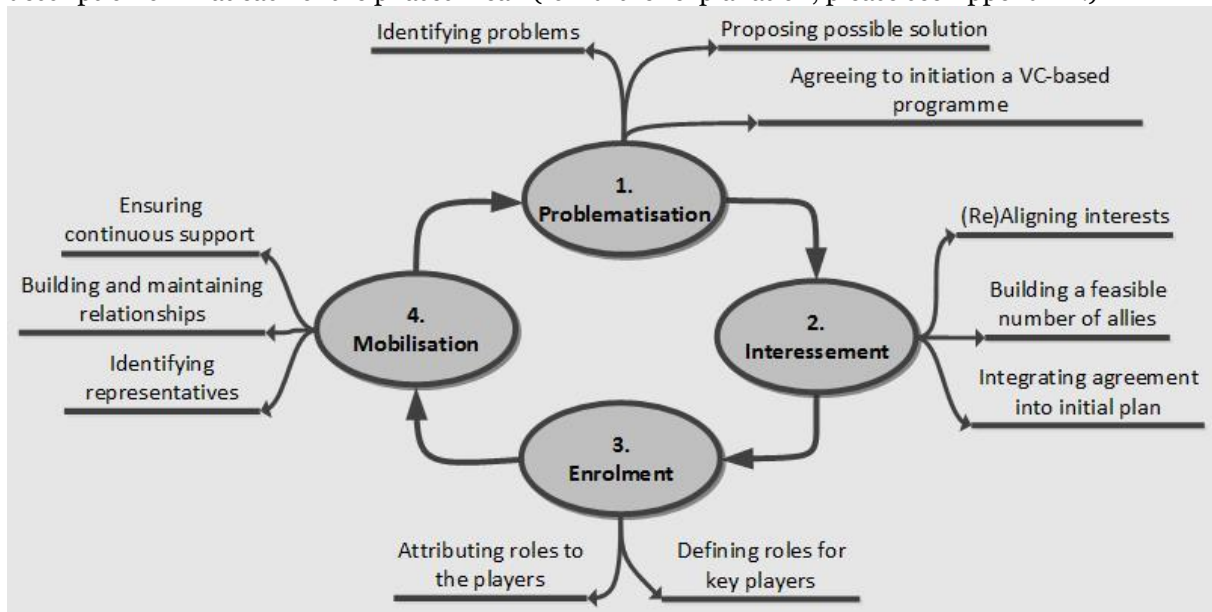


Figure 1: The four phases of Translation used to describe and analyse the C-Net cluster

### 4.1 Defining the Problem and Identifying the Possible Solution

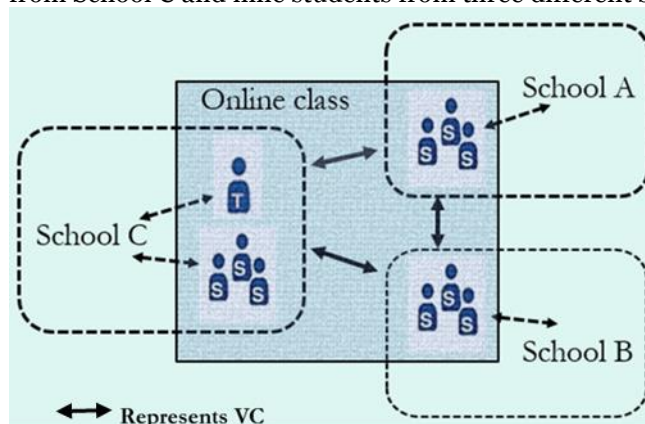
Participants from 26 rural and urban schools from a region of New Zealand attended a meeting in 2002. They were briefed about a new funding stream from the New Zealand Ministry of Education (MOE), aiming to integrate ICT into school practices and promote collaboration between groups of schools at regional and national levels for the professional development of staff. Out of the 26, six semi-rural schools found themselves fit for the funding criteria and were interested in the cluster-based collaboration as a unique solution for professional development of their staff. By up-skilling their staff, the schools could not only integrate ICTs into their classrooms but also overcome their limitations due to their geographical isolation. Their local economic development advisory trust (from now on EDA Trust) was also interested in that initiative because their aim was to foster regional development and connectivity in the region. Indeed, the EDA Trust was found to be one of the most engaged players in the initiation of C-Net. By the end of 2002, the seven members decided to form a cluster of six schools (we call that C-Net) and secured funding for the next three years. The EDA Trust signed the first contract with the Ministry on behalf of the schools and took on the role of fund holder and administrator.

Some variation of priorities existed amongst the schools in C-Net, which needed realignment. Most of the initiators were motivated to instigate a programme for embracing ICT-based development in their schools. However, some were desperate to initiate a programme for motivating and retaining their senior students and making the senior secondary part of their school’s curriculum viable. From the documents collected, it was revealed that the group of six schools had a very ambitious objective and forward-thinking approach. By the end of the three-year ICT PD funding, the schools had aimed “to have

achieved whole school change, with teachers integrating information and communication technology (ICT) into their regular programmes and classroom experiences more effectively”. In other words, the schools were aiming to shift the whole school learning paradigm from the traditional “stand-and-deliver” to a more advanced school system with a future-focused learning approach.

The research participants reported two major priorities or problems: the provision of professional learning and development (PLD) training for their staff and VC-based classes for their students. The schools were from a semi-rural region, with geographical challenges. Some of the six schools were small with a small number of senior secondary students and teaching staff. Those students had limited access to a wider range of curriculum options needed for their studies at school as well as future careers. Similarly, their staff members needed to improve their skills around the uses of ICTs for classrooms and exchange knowledge and experience with other teachers at their neighbouring schools.

Regarding a solution to the problems, information about the establishment of the A-Net school cluster was circulating in the school community in New Zealand around the same time. A-Net was developed around 2001-02 by some rural schools in the Otago and Canterbury regions of New Zealand. The schools initiated the model, now known as the Learning Exchange or the Virtual Learning Network (VLN), for the provision of a wider range of curriculum choices. The aim of the model was to help schools retain their senior secondary students. In the reciprocal or exchange model, existing human resources – teachers and students – and learning resources are exchanged between member schools. Member schools in a cluster used the VC system to connect two or more schools at the same time, enabling students to speak and listen as well as watch a real person talking at the same time. With the use of the VC, schools offer to teach each other’s students. If a school wants to receive a course, in return, they have to offer a teacher to teach a VC class based on the school’s capability and the availability of their teacher. By doing so, the schools maximise their existing education benefits and ensure efficient use of their limited resources. For example, Figure 2 illustrates an online class, a Level 3 Maths class with a teacher from School C and nine students from three different schools connected via VC and the Internet.



*Figure 2: An example of a VC class in the Learning Exchange*

The exchange model was collectively selected by the C-Net initiators as a good solution not only for making a successful funding application but also for achieving their two objectives. A team of three people was established as the project representatives. Two of them were principals from the member schools and were nominated as the project directors. A representative of the EDA Trust was selected as the project facilitator. The two principals were to engage with other principals, and the facilitator was to facilitate cluster operations and hold the funds. They managed the cluster activities from 2003-04.

Around 2005, the schools revisited the network’s activities and redefined their strategies. That was when the EDA Trust had left the cluster. During that re-Problematisation, the schools focused on the provision of wider curriculum choices for their senior secondary students over PLD for their staff. In fact, that was when some of the schools had their first student enrolment in the VC classes.

## 4.2 Identifying Potential Players

Informed by the original model, a number of potential players from within and outside a cluster are required for cluster self-sustainability. In order to fund the cluster operations and have a full-time cluster coordinator, facilitator or e-principal, the A-Net model suggests membership contributions. Since the Learning Exchange is a grass-roots level initiative, self-sustainability is paramount. Therefore, member schools share the cluster expenses by making regular financial and staffing contributions. The

more schools in a cluster, the more financial contributions are received from members, which lowered the financial overhead for each individual school. Specifically, for a cluster's financial self-sustainability, at least 10 committed member schools are needed, each with a 10% financial contribution and one e-teacher. Nonetheless, that contribution is only sufficient to cover the salary of a full-time coordinator, not any operational costs. Thus, remaining small is not feasible for any Learning Exchange cluster.

Regarding C-Net, participants revealed that bringing more schools into the cluster was highly significant in order to achieve bigger economies of scale and gain financial self-sustainability. Due to that reason, since 2002, C-Net initiators had tried to persuade their neighbouring schools to join C-Net. However, despite several attempts, the C-Net initiators could not convince other schools from their region to be part of the cluster at the initial stage. Later, in 2005, another two neighbouring schools decided to join the cluster, expanding the number of member schools from six to eight. Even with that expansion, the number was not sufficient to employ a full-time coordinator and cover operational costs, leaving the cluster to rely on external funding.

A mix of reasons was reported for that lack of interest amongst other schools in being part of C-Net. The first was accessing various funding channels, including ICT PD, multiple times rather than one huge region trying to split a single fund. Second, local values and needs differed between schools and different regions. For example, city schools mainly wanted access to more specialised subjects as compared to rural schools where they needed both generalised (such as level 1 maths) as well as specialised subjects (such as level 3 accounting). Third, geographically, schools in the region are not very far from each other and have a decent size student roll without the need to depend on enrolments in the VC classes for student retention. Fourth, within the cluster, existing member schools had different priorities. Those differences were because of their different school sizes, interests and needs. For example, some of the schools desperately needed the programme to get enough student enrolments and thus had a vested interest in the programme whereas others had not. Lastly, the dynamics and relationships between school leaders were another reported factor that stopped other schools from being part of the cluster.

In 2005 (the last year of the three-year ICT PD contract), some major changes occurred in C-Net. First, in 2005, the EDA Trust was no longer part of the group. The reasons for that change were reported to be the difficulty in maintaining a relationship with the outside organisation, the external facilitator situation, as well as having a lot of funds going into another organisation for organising the cluster. Second, at that point in time, the group of schools decided to select a coordinator for the cluster from within the local school community instead of having someone from an external organisation. Perhaps that was because the EDA Trust was unable to attract a number of staff members through the provision of PLD opportunities and students via VC-based classes. From the ANT perspective, those PLD and VC-based opportunities could have served as the devices of Interestement or tools for attracting potential players. The next coordinator was a deputy principal at one of the schools. In 2006, an ICT PD facilitator was selected to take the role of cluster coordinator and reorganise the cluster.

Due to the above series of challenges, the Learning Exchange programme and the cluster activities could not attract the minimum number of potential players that were needed for building a self-sustaining virtual community of neighbouring schools. The cluster continued with eight member schools and a minimal level of participation from within the local schools. In 2008, a new funding opportunity from MOE became a significant actant or player, playing a significant role in the growth of the network – at least for the two years of the funding. The next section reports that finding.

### **4.3 Defining Roles and Responsibilities**

Since the model was adopted from A-Net, various roles were also embraced in the same way. The roles included C-Net member schools, C-Net principals, lead teachers or e-deans, e-teachers, e-students, the EDA Trust, external funding sources and 'the things'. (The role of the EDA Trust has already been described in the above sections.) Although most of the other roles remained the same as in A-Net, their responsibilities, commitment or utilisation differed. As a result, the inconsistency partly played some role in the destabilisation of the C-Net school network. Some of the key findings are reported here.

The C-Net coordinator or facilitator role was first played by the EDA Trust representative. During that 2-3 year period, the role was responsible for administering the cluster activities and holding the funds and contract with the MOE. Later, the role was re-defined and given to an ICT PD facilitator from within the school community. In 2006, the facilitator was employed in a part-time (0.2) position that was increased to a 0.4 position, equivalent to two days' work per week. The role only became a full-time position in 2008-09 when the MOE announced two-year funding for facilitators or e-principals from about 18 Learning Exchange school clusters. The aim of the funding was to "maintain the cluster leadership and support cross-cluster relationship building with a key goal of e-learning cluster

sustainability”. In contrast, the responsibilities of the C-Net facilitator were reported to be mainly operational rather than leadership, influencing or having direct input into strategic decisions. Specifically, the facilitator was mainly required to lead the group of lead teachers in schools in order to mutually organise and support e-teachers and e-students in the member schools (see Figure 3a). That was in contrast to the role of coordinator in A-Net where the role has a significant input into strategic decision making (see Figure 3b).

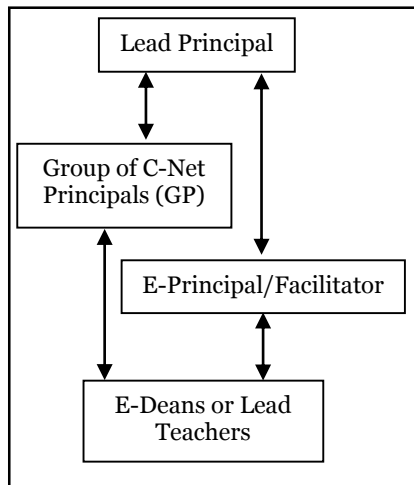


Figure 3a: C-Net Leadership Structure

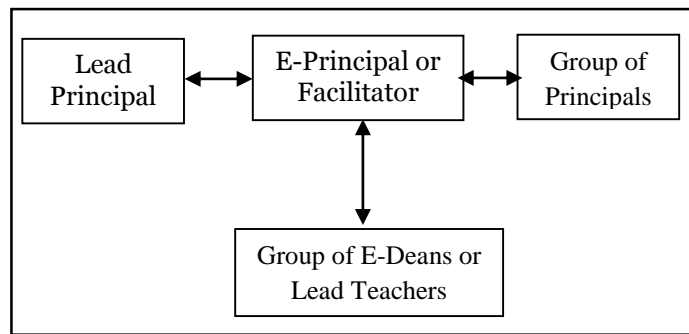
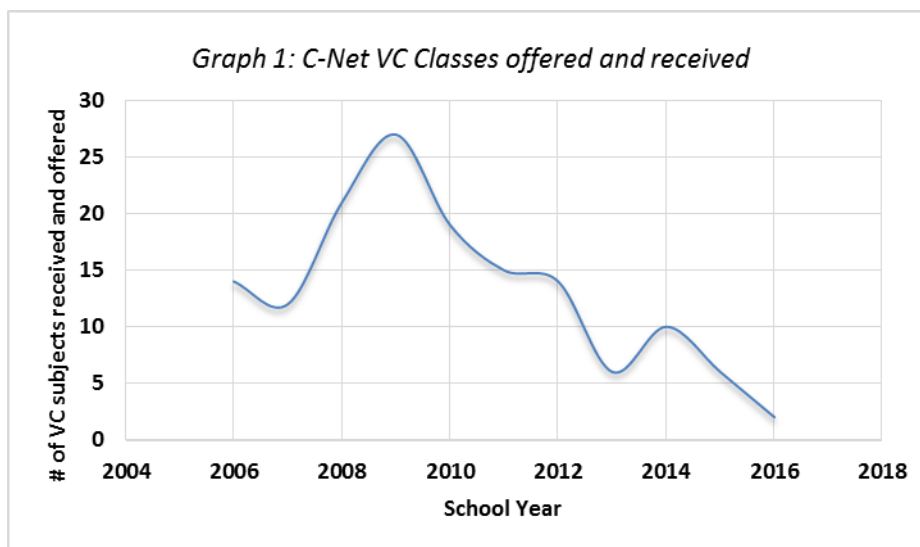


Figure 3b: A-Net Leadership Structure

With the end of that two-year funding, the group of C-Net principals decided to roll back the role of their e-principal to the 2007 position and offered the same part-time (0.4 staffing time) position. Their facilitator declined the offer and consequently left the cluster. The group of principals did not hire anyone else for the position. Indeed, one of their lead teachers was given some basic responsibilities of cluster coordination and training of any new e-teachers. Graph 1 shows that while the cluster had a full-time facilitator, a great level of momentum existed in the cluster. In addition, the Graph also indicates the role of the funding as a mediating actant for the establishment of a self-sustaining cluster. However, the Graph after 2010 shows that the actant was not effectively used.



The role of the lead principal in C-Net was created to represent the group of principals responsible for setting strategic directions and making strategic decisions for the cluster. The role was handed over to one of the C-Net principals for a 2-3 year period and then passed on to a different member school principal. It was reported that over the years, the original lead principals and the principals involved in the formation of C-Net had changed. With the gradual change, the nature of the relations between the lead principal and their facilitator had also changed, only to become more challenging. That was because the level of commitment and perception of the member schools with regard to online teaching and learning had weakened. As a result, C-Net had lost its value within most of the eight member schools and support from senior leaders.

With regard to the role of member schools, some were both supportive and committed, whereas others were not that interested in the cluster activities. For example, some of the schools were restrictive in their timetabling and conservative in exposing their students to the new environment that was necessary for their future learning and up-skilling. Indeed, they were reported to be “gate-keeping” their students’ registrations for the online courses and being “highly selective” in responding to their students’ applications to participate in online Learning Exchange courses. One of the reasons for that was reported to be an attempt to avoid providing any support for those students by only letting good students enrol in that environment. On the other hand, teaching staff at some of the member schools had no interest in teaching via videoconference in the Learning Exchange. That was because schools had not organised any PLD programme around teaching VC-classes. Indeed, one school had a less prepared staff member teach a VC course just to address a timetable scheduling problem.

In general, the role and responsibilities of an e-teacher were found to be the same as defined in the original Learning Exchange model set by A-Net. Mixed views were found regarding the role of e-teacher. Despite the negative perception of teaching a regular online subject and the absence of PLD for teaching VC classes, some of the e-teachers and their VC classes were reported to be very effective and highly successful. Indeed, one of the e-teacher’s classes had a better national record for scholarship results than any other e-teacher nationwide. Similarly, two senior language e-teachers’ classes from other C-Net member schools were always oversubscribed as more students wanted to learn from them. On the other hand, some of the e-teachers were reported to be not as effective as the three e-teachers mentioned above. That was reported to be due to the negative perceptions about the e-teacher’s role and the lack of support, such as PLD opportunities, from the schools’ senior management teams.

With regard to the role of ‘the things’, VC and other computer-based telecommunication technologies were the main tools playing a key role in the C-Net programme. Overall, research participants did not report any underperformance of ‘the things’ and were very satisfied with the performance of VC and other related technologies. However, the role of technology was under-utilised and was ‘black-boxed’. That was because the things had facilitated the provision of VC and their PLD opportunities, but they were not used efficiently for attracting a greater number of participants.

Participants were asked to report any changes such as enhancement, displacement, revival or production due to the tools. Based on the participants’ accounts of the events, the VC-based Learning Exchange programme was meant to equip the member schools with access to the ICT-based opportunities for staff and students. At the later stage, these tools were utilised to enhance the subject choices for the learners; however, they were underutilised for collaboration between teachers. The VC-based programme was used by the C-Net initiators to facilitate the displacement of the concept of face-to-face learning “to have achieved school change, with teachers integrating information and communication technology (ICT) into their regular programmes and classroom experiences more effectively”. This was the objective that the initiators had stated in their ICT PD funding application in 2002. Similarly, the tools had revived distance education and invigorated the regional schools, particularly their senior secondary level.

#### **4.4 Supporting Enrolled Masses**

Data were collected to identify what strategies had been determined and actions taken by the C-Net initiators for supporting their member schools along with their local e-students and e-teachers. That pastoral support from local schools as well as the cluster leaders aimed to help C-Net participants in (re)building and maintaining their relations in the C-Net school network. From the inception stage, the C-Net initiators representing the six member schools built their ICT infrastructure required for collaborative learning. They developed ICT infrastructure and accessibility for supporting their members.

However, that success was partial, because participants reported that there was no such regular professional development programme for supporting their teachers to up-skill their capabilities and to integrate ICT into their regular classes. Although the up-skilling objective was the very basis of their network’s formation, allowing the shift towards a new school paradigm, no indication of any real effort for achieving the objective was reported. In particular, such support programmes were absent during the first 2-3 years of the funding. In addition, no productive efforts for the enrolment of e-students in the VC classes were reported, nor was any real interest discovered that would have broadened the options for those students during the first couple of years of the C-Net initiation. Participants reported that was because there was no e-principal or ICT PD facilitator to cater for the needs of their staff and students. The EDA Trust was a player from outside the immediate school community. The lack of top leaders’ support was reported as other reason. As one participant reported, “Need to have principals who are actually passionate about it and motivated to support it [the programme]”.



After re-strategizing the cluster's directions in 2005-06, there were more e-students and e-teachers participating in the programme. Since the environment was virtual, e-students and e-teachers needed a different set of skills. They needed deep, pastoral, local support mechanisms for maintaining their presence, (re)building relations in the online space and thus gaining those skills. That kind of support was reported to be very important particularly for e-students having their first experience of VC. However, a good level of support was not available.

The member schools had that responsibility of providing the required support. Indeed, a key part of the role of lead teachers and their facilitator was to ensure the provision of such support and they employed an ICT PD facilitator to further extend the level of support and collaboration between the member schools. Instead, participants reported that some of the schools had only made the programme available to the highly competent e-students who would not require or expect to have a great level of support from their schools. Regarding the support for teachers' up-skilling, in the absence of any formal professional development programme for teachers, no need for support was indicated by the participants.

Graph 1 illustrates an increased numbers of classes around 2008-09. That was because of the funding and employment of a full-time facilitator, facilitating strong leadership in the cluster and ensuring a good level of support and coordination. According to one of the participants, cluster activities had increased considerably with that e-principal funding from the MOE, but after that everything just faded away. According to a document, that fund was meant to develop a sustainable cluster by the time the fund came to an end. However, the reality of the disappearance of C-Net indicated otherwise.

Based on the participants' input, from 2010 onwards the cluster can be reported to have slowly disappeared with a very minimal level of activity and a very small number of participants from individual schools. In 2010, after seven to eight years of participation in the Learning Exchange, most of the C-Net member schools showed no interest in continuing their cluster as a collaborative group of local schools. Thereby, the cluster disintegrated and gradually disappeared. Some of the member schools were reported to have been desperate for the continuation of the programme, whereas for some that was not the case. As a result, a couple of the schools had to continue individually instead of participating in a collaborative group. As of 2016, only one of the schools was participating in the Learning Exchange with a very minimal presence.

## 5 Discussion

Based on the findings above, multiple obstacles to a successful C-Net Translation can be identified. First, C-Net was an opportunity-driven rather than a problem-based initiative, because the ICT PD funding triggered their formation rather than any problem. Because the funding was available, the schools thought that clustering of schools by adopting the Learning Exchange was relevant for making a funding application. In contrast, the actual Learning Exchange model was designed from the outset as a problem-based initiative for retaining senior-level students and facilitating collaboration between their staff. The claim is further supported by the fact that C-Net participants neither reported any formal PLD programme for staff members nor had they achieved a relatively high number of student enrolments in the VC classes, particularly during their early stages. In addition, the EDA Trust, an external player from outside the school community, was given a very key role. The decision was problematic because the player failed to focus on teaching and learning in terms of PLD for teachers and the VC classes for students. As a result, neither of their two objectives was addressed during the C-Net's earlier stage.

Because of that early poor leadership and leadership set up, the cluster initiators could not realign their members' interests and thus remained disintegrated. Since the schools were of different sizes, their student rolls, financial and human resources, as well as their needs and priorities were different. The leadership team failed to align their differing priorities and deeply integrate C-Net within the member schools. Consequently, there was a divergence of interests without a clear definition of C-Net philosophy. The re-definition of the Problematisation or the cluster philosophy after a couple of years did help the cluster to strengthen relationships and links between the actants. However, that proved to be for a short period of time since their financial strategy remained the same – reliance upon external funds. These issues affected the Translation before the Interessement was started. Table 1 summarises some of the key factors keeping C-Net from developing as a self-sustaining cluster.

<b>Inhibiting factors</b>	<b>Barriers to the self-sustainability of C-Net</b>
Mismatched problem-solution definition	Opportunity-driven instead of a problem-based initiative, leading to mismatch between the identified problem and the solution
External player having a goal-setting role	Inappropriate selection of focal player
Divergence of interests	Weak alignment of priorities/interests and establishment of philosophy
Small size leading to financial dependency	Small number of members unable to form a feasible group required for financial self-sustainability
Absence of resourcing strategy	Lack of willingness within cluster leaders for increasing the number of schools required for a considerable exchange of resources
Underutilisation of existing resources	Ineffective use/marketing of existing PLD and VC programmes for attracting participants from within and outside C-Net
Vertical leadership structure	Ignoring cluster facilitator/e-principal role and input during the strategic decision-making process
Leadership changes	Changes of original principals and lead principals in the member schools leading to a diluted cluster vision, affecting schools' as well as students' and teachers' roles
Weak local support	Network leaders failing to provide pastoral support to participants within local schools and cater for their needs
Conservative attitude of member schools	Schools avoiding exposing their students to the new environment for some short-term gain

*Table 1: C-Net Inhibiting Factors*

During the Interessement, C-Net initiators could have gained financial self-sustainability by expanding the cluster through increasing their membership. Due to the poor early Problematisation, C-Net initiators did not focus on the PLD opportunities for their teachers and VC classes for students. Those PLD and VC programmes could have served as the devices of Interessement or tools not only for attracting a sizeable number of participants from within the cluster, but also for increasing the membership base. Nonetheless, the absence of such a long-term strategy and the underutilisation of their existing resources indicated a lack of willingness amongst school leaders for expansion. Otherwise, with more than 10 member schools, C-Net could have formed a feasible group for sharing the cost of a full-time facilitator position and moving towards financial independence. Notwithstanding, the cluster remained small with limited resources and thereby relied upon external funding for running the cluster with a full-time facilitator.

The Enrolment phase was first affected during the early Problematisation due to the poor selection of the EDA Trust as the main driver of the programme. Although the role of the ICT PD facilitator was later redefined around 2005-06, the role had a low profile which only involved operational responsibilities without having any strategic impact. In that vertical leadership structure, the role could not influence the development of a cluster vision with a dimension of self-sustainability. With the assistance of e-principal funding in 2008-09, the role did have some positive impact by increasing the level of participation from within the cluster. However, with new principals replacing original and lead principals over the years, the role of cluster facilitator was incorrectly seen as inessential and was not valued as a full-time position once the external source of funding stopped.

Similarly, challenges were found during the C-Net Mobilisation phase. The weak support mechanisms at the local schools was one of the key challenges. The purpose of deep, pastoral, local support is to ensure that participants maintain their enrolment in the network and continuously (re-)established their links with other participants. With the provision of deep local support, school leaders also establish their legitimacy as C-Net representatives. During the initial stage, focal players had successfully represented the schools by developing the ICT infrastructure required for the network formation. However, the initiators had ignored the enrolled e-students and e-staff through focusing on the provision of VC classes and PLD opportunities. That was particularly significant and relevant when the funding was for PLD and ICT purposes. Regarding the support for e-students, schools had a conservative attitude towards exposing their students to the new environment. Some were gate-keeping their student applications in order to avoid any workload due to the provision of such support. In 2008-2009, during the MOE funding, their facilitator role became full-time and was available to provide more support. That development did boost the enrolments and e-classes. However, the school leaders could not capitalise on that opportunity by continuing the pace of the development. In fact, when the funding stopped, the network was rolled back from 2010 to the 2005-2006 position. Since that decision, the network can be

reported to have slowly disappeared with some exceptional single enrolments of students and teachers teaching in the network.

## 6 Research Implications, Limitations and Conclusion

While these findings are highly contextual, the research implications can be applied not only to the self-sustainability of the Learning Exchange clusters in New Zealand but also for clusters operating in a similar context worldwide.

This particular case is also a single illustrative case study example, this paper reports on the inhibiting factors specifically in the development of this single cluster and does not attempt to focus on the supporting factors that may have also been present. Although in this case any supporting factors were clearly eclipsed by the inhibiting factors that led to the clusters eventual demise. The lessons able to be drawn from this experience, while contextually sensitive, are still of general value to researchers and practitioners of virtual cluster collaboration.

Overall the findings suggested that, based on their needs, demographics, and available resources, member schools were required to adapt and embrace the new pedagogies in order to gain a paradigm shift. Without a clear vision, full commitment and forward-thinking approach, cluster members could not overcome the challenge of maintaining relations in the virtual environment and integrate the new system of learning with their traditional educational processes. The set of identified challenges could be used as dimensions of any self-review process by the clusters for their sustainable development.

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## Appendix 1

ANT Concept	Brief Description
Translation	This is the programme of action which is concerned with “how actors and organizations mobilize, juxtapose, and hold together the bits and pieces out of which they are composed” (Law, 1992, p.386).
Problematisation	This is the first phase of Translation in which initial actors identify a problem and propose a possible solution. Then some of the initiators become ‘focal actor’ to represent the network (Callon, 1986).
Interessement	During the second phase, focal actors try to “convince other actors, whose interests are in line with the initiators’ interests, to join the network” (Tsohou et al., 2013, p. 41). Focal actors use various strategies to reach the Interessement goal (Wissink, 2013, p. 5).
Enrolment	The third phase of Translation process “involves a definition of roles of each of the actors in the newly created actor-network” (Mähring et al., 2004, p. 214).
Mobilisation	The final phase is to ensure that initiators are representing and supporting the enrolled masses (Postma, 2009). Initiators ensure that all the actors work together to maintain the problem-solution definition and keep other actors enrolled in the network (Vos, 2014).

Table A1: Four phases of Translation

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