The dynamics of an online knowledge building community: A 5-year longitudinal study

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Abstract

This paper reports a 5-year design experiment on cumulative knowledge building as part of an international project. Through a longitudinal study and analysis of cumulative research data, we sought to answer the question, ‘what happened and why in knowledge building?’ Research data constitute messages which participants have written into a shared knowledge building database. A multi-method approach combing quantitative and qualitative data was adopted which integrated analysis of message generation, content analysis, network analysis, structure of message threads, discourse analysis and interviews. Conclusions are based on analysis of almost 2000 messages. Qualitative content analysis reveals 14 main categories of data. When the content of the messages are analysed, quantitatively cumulative trends emerge. When the frequencies of messages are plotted against time, peaks and troughs of message writing are revealed. The explanations for these patterns and variations are sought through interviews. Social network analysis shows that the network is centralised. The research literature suggests that decentralised networks are ideal, but in this particular case, the expert centralisation was beneficial for knowledge building in the collaborative and associated professional networks. The reasons for this are discussed.

Introduction

The purpose of this research is to learn more about the processes of cumulative knowledge building in order to create, maintain and improve knowledge building systems through which some of the complex problems of modern knowledge societies might be addressed. The research is based around cumulative knowledge building in an
international project of Environment and School Initiatives (ENSI) (Mylläri, 2006). Because this longitudinal design experiment is over several years, it provides new insights into cumulative knowledge building in educational situations.

ENSI has a record of over 20 years of innovation and action research in environmental education (EE) and education for sustainable development (ESD). ENSI is an international school research and development network established in 1986 under the auspices of the Organisation of Economic Cooperation and Development (OECD) Centre for Education Research and Innovation. Its original research innovators were professors Peter Posch and John Elliot (Åhlberg & Heinonen, 2004). OECD has 30 member countries sharing a commitment to democratic government and the market economy. Best known for its publications and its statistics, OECD’s work covers economic and social matters from macroeconomics to trade, education, development, and science and innovation. During 1986 to 2005, ENSI grew into a prominent global EE and ESD project. According to Rauch (2002), ENSI is seen as a breeding ground for promoting innovations.

The years 2005–14 are the United Nations’ Decade of Education for Sustainable Development, coordinated by United Nations Educational, Scientific and Cultural Organization (UNESCO). To mark this, ENSI adopted the idea of cumulative knowledge building. It was decided that the Finnish ENSI team, with funding from their Ministry of Education, should test cumulative knowledge building through the platform known as Knowledge Forum®. In 2000, one of us (MÅ) visited professors Marline Scardamalia and Carl Bereiter at the University of Toronto to study knowledge building with the online environment Knowledge Forum®. The experiences from the first year of the Finnish work in the ENSI project with Knowledge Forum® on the themes of ‘learnscapes, ecoschools and teacher education’ were very encouraging (Åhlberg, Kaasinen, Kaivola & Houtsonen, 2001).

The research reported developed from the experiences of the Finnish work, and involved a learning community, which included representatives from schools (principals, teachers), universities (professors, researchers, students), the National Board of Education (educational administrators) and the international ENSI/OECD/UNESCO programme. An important goal was collaborative knowledge building to promote EE and ESD as part of teacher in-service education. No roles were explicitly allocated within the community, although one of us (MÅ), as the main researcher and supervisor of the several Finnish participants researching for academic theses as part of the project, was recognised as facilitator.

Knowledge Forum® is an open and flexible collaborative environment for knowledge building developed at the University of Toronto. When knowledge is constructed collaboratively, a shared workspace is used into which every member of the community may contribute messages (also called ‘notes’). Messages may consist of text, diagrams or images. When a message is closed, an icon of it, with the title and the name of the author, is displayed. It is possible to open other people’s messages and construct
'build-on messages', and by doing so, develop the ideas of the original writer, possibly in ways that the original writer could not imagine. Knowledge Forum® makes it possible to integrate the knowledge and skills of a number of participants. The build-on message is shown as a line from the first message to the second message. It is possible to quote from other peoples’ messages by selecting and copying text between messages. Quotation marks appear with an icon that refers to the original message. Clicking the icon opens the original message as a whole and reveals the context from which the quote came. The database may be divided into ‘views’. Messages may be moved or copied from one view to another. The database may be searched by keywords, authors, dates, etc. It is the cumulative nature of Knowledge Forum® that is the focus of this paper.

In the research reported here, knowledge building is used in the sense outlined above and explained in detail in Scardamalia and Bereiter (2006) (Figure 1). The research is conceptualised through the ‘integrating’ theoretical framework of Dillon and Åhlberg (2006). The notion of ‘integrating education’ has itself been developed collaboratively and cumulatively over many years:

... learning may contribute to a collective vision that is strongly motivating and leads to a shared positive view of core processes, roles and responsibilities. Both the vision and the strategy for accomplishing it are subject to continual scrutiny and constructive criticism. The purpose is to broaden both thinking and the possibilities for personal and collective action. (Dillon & Åhlberg, 2006).
Cumulative knowledge building incorporates elements of both collaborative and cooperative knowledge building. It is the systematic, incremental, integration of new knowledge with existing knowledge that makes it cumulative. This is typically associated with continual quality improvement through constructive scrutiny and criticism, followed by practical application, leading to improvements in practice, which are both theoretically and empirically based. The Finnish ENSI community is ‘distributed’ in the sense that the participants are separated geographically and temporally when using Knowledge Forum® and applying outcomes in their own institutions. However, twice a year, they meet face to face to discuss environmental and sustainability education and review initiatives of common interest like improving school environments and biodiversity. The local application of knowledge means that knowledge developed cumulatively may have practical manifestations in very different ways. For example, of the two most active Finnish schools, one is rural, the other is urban. Representatives of the two schools were party to the same collective thinking and exploration of possibilities, but the practical actions were very different. This is a manifestation of what Dillon (2008) has called ‘niches of cultural production’, reflecting the ‘particularity, subtlty, idiosyncrasy, and patina of locality at scales, at time frames, and through modes of organisation appropriate to those places and the enterprises within them’.

In this paper, 5 years of data arising from the use of Knowledge Forum® by the Finnish/ENSI community are presented. The focus of the paper is on the dynamics of cumulative knowledge building rather than the content of the knowledge produced. The frame for analysing data was derived from the ‘mutual shaping lens’ of Boczkowski (1999, 2004) which he developed through research into how the introduction of digital technology changed news production and social networking processes, and the identities of the individuals involved. The research reported here describes changes in both the social and the technological elements of the knowledge building community. Social lenses into the community are: the active participation formations (through quantitative analysis of the database); the structure of the interaction network (through network analysis); what the participants in the knowledge building community perceive to be the meanings of their participation (through interviews); and the content and the structure of knowledge building (through content analysis and discourse analysis). The technological lenses are: the structure of message threads produced by the community; the way in which the knowledge building community structures the content (knowledge building ‘views’); and the relation of both to development and variation during the 5 years of the study. Collectively, these lenses provide a cumulative picture, an integrated ‘total environment’ view of the dynamics of knowledge building.

Methods
Messages which participants wrote into the shared cumulative knowledge building database provide the research data. A multi-method approach combining quantitative and qualitative data (Brewer & Hunter, 2005) was adopted, which integrated analysis of message generation, content analysis and structure of message threads. The same data were also subjected to social network analysis (Wasserman & Faust, 1994), in particular, using UCINET (Analytic Technologies, Harvard University, Massachusetts, USA)
software (Borgatti, Everett & Freeman, 2002). Data were also derived from interviews with: (1) participants who were continually active in the knowledge building system, (2) participants who were active in its earlier phases only, and (3) passive participants.

**Message generation**
Knowledge Forum® 3.4 analytic toolkit, developed at Toronto University (OISE, 2002), was utilised for reading the content of the database and the metadata for each message, which records its provenance. The analysis provided information about who wrote what and when, and how the messages built cumulatively.

**Content analysis**
Messages were read and categorised. First, each message was put into a single category. These categories had been established in advance through the ENSI project agenda and reflected the core business of the project. Next, all messages were recategorised so that the categories better reflected the developing structure of the knowledge building. During subsequent discourse analysis, categories were confirmed.

**Network analysis**
This again utilised the software, developed at Toronto University, in this case, to provide the data sets for network analysis as revealed through the ‘build-on’ structure of the knowledge building network. ‘Build on’ is the term used in Knowledge Forum® to show who is replying to who in messages and the frequency of these transactions (known as the ‘tie-strength’). Network analysis is performed on the data sets compiled with the Knowledge Forum® 3.4 analytic toolkit, which is used to visualise the patterns and centralisation of interactions and relations between nodes. From the large family of network analysis algorithms, visualisation is obtained by multidimensional scaling of nodes. Nodes represent geodesic distances between actors, participants in collaborative knowledge building. A geodesic is the shortest distance in the interaction network between two nodes, and the multidimensional scale algorithm arranges nodes with similar sets of geodesic distances spatially close to each other. In addition to a visual representation of the relations of nodes, the centralisation of the network as a whole can be obtained through the same analysis. To further deepen the understanding of the interactional entirety of the community, data derived from writing activity, actor occupation and reciprocity of the connections are included in the analysis.

**Structure of message threads**
This again utilised the software developed at Toronto University (OISE, 2002) to derive quantitative data from an extension of the message generation analysis. It shows for each message thread: the number of messages; the number of active message days; the number of participants; and the number of days between the first and last message.

**Discourse analysis**
This is concerned with the sequential organisation of discourse in collaborative knowledge building. Analysis followed the scheme of triadic dialogue proposed by Sinclair and Coulthard (1975), and applied by Wells (1996) in which there are three types of moves.
(or ‘turns’) associated with reacting to previous discourse (initiation, response and follow-up) and three types of prospectiveness of the turn associated with restricting or affecting the next turn (acknowledge, give, demand). Wells analysed classroom discourse (ie, speech), and Schrire (2006) has applied this to online (written) discourse. Schrire’s approach was adapted to written discourse in which a variety of different styles of writing were represented, especially for analysing message threads with messages containing long passages of text that combined material and references from long periods of time. Two things were of interest: (1) participants’ reactions to previous discursive ‘turns’, and (2) affects on the next (subsequent) ‘turn’.

Interviews
These were semi-structured, themed interviews. They were undertaken at the end of the period of research. Participants from each phase of knowledge building were interviewed, 11 in total. They were selected to represent the greatest variation in participation, from most cumulative knowledge building to little or none at all. Questions were asked about: benefits to their professional work through participating in knowledge building; what explains variation in activity from the respondent’s viewpoint; and what type of episode the respondent remembered. Interviews were transcribed. Thereafter, categorisation was through: (1) themes emerging from the transcriptions, for example, the role of the central actor and the constraints of time, and (2) Nuutinen’s (2006) framework for expert identity, which is based on (1) sense of professional control, (2) sense of professional competence, and (3) the meaning of one’s professional role in wider society.

Results
What follows is an account of what happened and why in cumulative knowledge building in the Finnish ENSI project 2000–05. The data are presented as a series of figures providing a visual representation, which is in itself cumulative.

Message generation
Figure 2 was generated in Microsoft Excel by feeding in the number of new messages per day from the database reading software, Knowledge Forum® 3.4 analytic toolkit. The database and the Finnish ENSI project documentation provide the ‘obvious reasons’ for variation, especially the highest peaks and longest breaks.

Message generation shows: (1) variation in composition of group (who is present and who is active)—1 day had 45 notes but there was a 3-month period with nothing; (2) reasons for peaks and troughs, for example, in the light of subsequent analysis, it was established that peaks are associated with times when participants are familiarising themselves with the knowledge building software, and troughs are associated with server breakdowns. These are obvious and predictable patterns; and (3) variation in writing activity beyond the obvious, for example, after a certain time, the peaks do not synchronise with face-to-face meetings. The main reasons given for this were time and motivation related: participants liked face-to-face meetings in dedicated time, but the
hard work of thinking, writing and taking part in cumulative knowledge building required a different level of motivation.

Figure 2: Message generation activity

The obvious patterns evident here are that the participation falls into three formations, or ‘phases’: the participants ‘then’ (ie, those present in the early phases of knowledge building); the participants ‘now’ (ie, those present in later phases); and a period where the two groups coexist and written records in the database overlap. These groupings were adopted to help focus the analysis of subsequent data (Figure 3).

Figure 3: Active participation formations

The obvious patterns evident here are that the participation falls into three formations, or ‘phases’: the participants ‘then’ (ie, those present in the early phases of knowledge building); the participants ‘now’ (ie, those present in later phases); and a period where the two groups coexist and written records in the database overlap. These groupings were adopted to help focus the analysis of subsequent data (Figure 3).
Content analysis

Content analysis shows how themes within the project developed and affected the subsequent course of knowledge building (Figure 4). Early exchanges are ‘routine’ (e.g., software familiarisation, exchanging information—the ‘other’ category in the figure). Then, a threshold is reached, dominated by two interrelated categories (1) concept formation, and (2) relating concepts to the developing programmes of EE of the individuals concerned in the schools in which they worked.

Figure 4: Content analysis showing development of categories
EE, environmental education; ENSI, Environment and School Initiatives; ESD, education for sustainable development; OECD, Organisation of Economic Cooperation and Development; SEED, School Development through Environmental Education.
Figure 5 shows which participants focus on which categories, and the relative prominence of different participants and categories. The relations between participants and categories show three dominant foci. They are: (1) individually orientated, where a participant discusses only matters that are of direct relevance to his or her interests; (2) group orientated, where participants discuss matters that are of collective interest; and (3) ubiquitous orientation, where a participant is active in all categories.

Figure 5: Content analysis showing most active participants
EE, environmental education; ENSI, Environment and School Initiatives; ESD, education for sustainable development; OECD, Organisation of Economic Cooperation and Development; SEED, School Development through Environmental Education.
Network analysis

How to interpret Figure 6: (1) spacing of nodes: the software places close to one another nodes with similar connections to other nodes; (2) size of node: this is based on the total number of connections; (3) colour of node: the number of common links within the group (see key); (4) shape of the node shows occupation groups: down triangle = university, up triangle = school, square = administrator, hourglass = indefinable (ie, no personal information in the database, no regular participation), circle = server maintenance; (5) tie-strength is related to thickness of connections, the ‘thicker’ the connections, the more knowledge building; and (6) tie-colour: blue = unidirectional messages, red = reciprocal messages. This figure shows one actor to be very prominent and central for almost all of the activity clusters around the subgroups.
Structure of message threads

The message threads are arranged chronologically from left to right by their starting dates and so, while viewing Figure 7, one should remember that the x-axis is not a steady time scale. The dashed blue boxes indicate actual ENSI years. The top left graph shows the number of days between the first and last message. Threads that started in the first phase of knowledge building lasted for relatively long times. Only two threads from phase III lasted longer than 200 days. The top right graph shows actual activity, and the bottom left graph shows message counts. Taking these together, it can be seen that the knowledge building community comes to life in the last phase. Message threads are ‘alive’ only when people invest their time (active days) in writing (message counts). Major differences in the dimensions of threads between phases I and III are evident.

Message counts and active days both increase with active participant formation (ie, concept formation, collaborative knowledge building). Participation increases as the purpose/locus of the group becomes better focused. With the passage of time, threads bifurcate into a number of sub-threads rather than new separate threads being formed. As the collaborative knowledge building community ‘matures’ (ie, the participants get to know each other better, and become more familiar with the tools), there is more cross-referencing and consolidation between threads and sub-threads.
Figure 8 presents a visualization of the same data presented in Figure 7. However, in Figure 8, the development of parallel activities in Knowledge Forum® is more effectively illustrated. The interpolated dots in the chart represent the active days of an individual message thread. It can be seen how there are several, simultaneously active threads during the first phase of knowledge building. This ‘parallel action’ dies out during phase II, and the knowledge building discourse starts to focus on only one or two threads at a time during the second and, especially, the third phases. The blue boxes indicate the message threads that were selected for the discourse analysis.

An even greater insight into the development of parallel actions in Knowledge Forum® and the factors affecting it is evident from Figure 9. Here, the interpolated dots in the chart represent the active days of an individual knowledge building view. The same phenomena as with the development of message threads are present also in the activity in individual knowledge building views. It can be seen how the action starts to focus into one or two knowledge building views at a time. Here, it is important to remember that a knowledge building view can be seen as the ‘reserved place’ in Knowledge Forum® for the knowledge building of a certain theme or over a certain period. Views represent the main ENSI themes: ecoschools, learnscapes and biodiversity education.

**Discourse analysis**

The data described here are analysed for prospectiveness (the relation between conversational turns, which are responses to previous turns in the dialogue, and future directions of the dialogue), which in turn can be cross-referenced to thread measures.
Figure 10 shows how the proportion of responsive turns increases with progression through the phases. This is reflected in the analysis of the structure of message threads.

Figure 10: Frequency of types of turn (moves) in knowledge building discourse
msgs, messages; mts, message threads

Figure 9: Number of days between first and last active day in the knowledge building view
KB, knowledge building

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It can be seen that in the first phase of knowledge building, the participants tend to write many messages that contain information about themselves or the programmes they are involved in at their workplaces, which can also be seen in the relatively high proportion of initiation turns. Vice versa, as the discourse evolves through the research period, the responsiveness towards other participants’ turns becomes higher. The increase in responsiveness should also be seen as an obvious outcome of the writing of the community focusing on single message threads and knowledge building views during and after phase II of the research period.

Concerning the phenomenon of restricting the next discursive turn in a message thread, it can be seen that acknowledging turns in messages increases with progression through the phases (Figure 11). In phase II, there is an increase in the giving of information, which is explained by new participants joining knowledge building and presenting themselves by reporting their own programmes and professional plans. The decrease in ‘demand’ messages can be understood through the fact that the isolated questions in the messages from the first phase of knowledge building have gone, and, in turn, the portion of responsive discursive turns in the messages towards other participants’ reflections have increased.
Figure 12 is a comparison of two message threads from phases II (message thread 15, left) and III (an extract of message thread 67, right). To visualise the differences in knowledge building activity, the results from analysis of message generation, content analysis and discourse analysis have been combined. The boxes represent messages, and contain the identity of the writer and the sequential number of the message in the thread. Different colours represent the content categories into which the messages have been categorised. The left side of the labels of the connecting lines shows the type of turn (move), and the right side of the label shows the degree of prospectiveness. The furthest right arrow represents time and labels the active dates of the thread.

The particularities of the comparison seen in Figure 12 are that typically, for phase III of the research period, the knowledge building discourse combines all the different topics into a single thread. In doing so, the turns in the discourse follow up or respond not only to the messages they reply to, but also to messages (and individual turns in them) from further back in the thread’s history (see dotted lines in Figure 12). This can be seen as an evolution of the discourse from a strict and agenda-driven (single content) style towards an enduring and more integrative one.

The application of discourse analysis in this kind of setting should be evaluated very critically. In analysing the large amounts of text in the individual messages that form message threads, it becomes obvious how the discourse of online knowledge
construction differs profoundly from face-to-face dialogue, for which the discourse analysis framework was originally developed. Over the period of the research, the knowledge building discourse moved in diverse directions. This makes the application of the method very prone to instability. Notwithstanding these reservations, the analysis produced information that is very valuable for the original goal of studying the relations of social and technological elements of knowledge building. The representations of analysed message threads, such as the one seen in Figure 12, that combine the results of content and discourse analyses reveal the socially multidirectional and topically layered nature of the knowledge building discourse developed over the 5 years period.

Interviews
The interviews, using Nuutinen’s framework, reveal that in phase III of knowledge building, participants expressed that they felt themselves to be experts on knowledge building and that knowledge building is an essential part of their professional identities.

The interviews also provide more insight into why some of the peaks were not synchronised with the ENSI project’s face-to-face meetings (see also the ‘message generation’ section in the Results). First, some of the peaks represent independent rehearsals and experimenting done with the software by the individual participants. Second, peaks were associated with other kinds of themed meetings outside the ENSI project’s agenda where the use of Knowledge Forum® was applied and facilitated in local school settings, for example:

Author A0RAE: Once A0YHA visited our school. During his visit ... we put some of our schools plans into Knowledge Forum®.

Third, especially towards the third phase of the project, when some members of the community were writing their theses, the need for immediate feedback on individual contributor’s notes was a crucial aspect of the process. This is illustrated in the two excerpts of interviews below. Participants may have written several notes on different aspects of the thesis during one session, and the tutor had provided feedback for them all. These exchanges may have taken place during the same day.

Author A1OUI: ... but the best thing there is, is that A0YHA, who’s been the facilitator here, has always been actively commenting ... and I think that considering studying in the university in general, it’s not possible to achieve [with the tutor] the kind of an interaction happening here in the knowledge building ... that could have been ever better, if one would only have had the time.

Author A0YHA: My conception from my own experience is that one hopes that someone would react as soon as possible. Who ever there is, should do that [react as soon as possible], that’s one of the main qualities. Even with email it feels rather impolite, if someone doesn’t answer. So, even how ever little text you receive, just something very quickly and you can keep on continuing.

The interview data also deepen the understanding of the orientations described in Figure 5. The participants can be seen adopting different roles and positions within the knowledge building community. These roles and positions are developed over time, and they can be regarded as online extensions of real-world activity. For example, the patterns of participation exhibited by participants A1OEE, A1OUA and A1OLN are associated with joining the project during phase II (see Figure 3) while undertaking thesis work and taking part in the face-to-face meetings, activities which are mentioned in the
interviews (see examples below). Note how these participants are referring to each other. The ubiquitous presence of A0YHA (the tutor) is a manifestation of the need for him to give immediate feedback to the participants writing their theses, and further strengthens the argument about the importance of the centralised role in this community.

Author A1OEE: ... A0YHA is naturally commenting a lot as our [thesis] instructor and A1OUA has in her own way her own studies [... but you just can’t get everyone in there no matter how you try]

Author A1OUA: ... and that was about it with A0YHA, but the final linkage came through A1OLN, who helped us there [on Knowledge Forum] by giving us practical advice.

Other outcomes of interviews, confirming perspectives generated elsewhere in the data analysis, were: (1) everybody acknowledged the importance of a ‘central actor’ in knowledge building, (2) everybody commented on the time commitment required to be involved. Time constraint was the main reason given for ceasing to be involved in the community, and (3) confidence about expressing ideas in a forum of peers was identified as a major inhibiting factor.

**Cumulative knowledge building**

Although the focus of this paper is on the dynamics of cumulative knowledge building, Figure 13 and its associated commentary provide an example of knowledge building discourse and how it may be tracked through the Knowledge Forum® framework.

![Figure 13: Example of the knowledge building discourse from a message thread, from the beginning phases of the project](image)
In figure 13 a message thread is opened in Atlas.ti software where the coding was performed. The right side of the figure shows how the coding scheme is applied. The translated text can be seen in Example 1. Example 1 demonstrates how even this kind of message thread that contains only limited amounts of text per message easily starts to break away from the kind of discourse that was the original object for the developed analysis method (see messages 3 and 4).

Example 1.
Message 1:
Author: A1OUI
Title: What is an Eco-School?
Message (Note): “Where do I get the criteria, according to which I’m allowed to call my school an Eco-School?”
Move function: Initiate (I)
Move prospectiveness: Demand (D)

Message 2:
Author: A0YHA
Title: Defining features of an Eco-school
Message (Note): “When sustainable development is truly tried to achieve, the School can well call itself an Eco-School”.
Move function: Response (R)
Move prospectiveness: Give (G)

Message 3:
Author: A1HII
Title: Eco-Schools
Message (Note): “The answer is not complete at this rehearsing stage. In Germany I suspect they are ‘Green Flag’ –eco-schools as well as in Sweden. They have their own criteria. We can use them.
Move function 1: Response (R)
Move prospectiveness 1: Give (G)
We can also define our own, Finnish Eco-Schools. What is an Eco-School in ENSI-project: in schools everyday practices and teaching works according to sustainability, an exact criteria doesn’t exist (at least I don’t have them). Can we create common ENSI-eco-criteria (Finnish made)?”
Move function 2: Initiate (I)
Move prospectiveness 2: Demand (D)

Message 4:
Author: A1OUI
Title: Eco-Schools
Message (Note): “I would be interested in developing criteria. If we can form a group, it shouldn’t be a big task because Green Flag –Eco-Schools already have a good basis. But they, if I’ve understood correctly, focus on the physical criteria for the Eco-Schools and we’re supposed to have the teaching meet certain standards.”
Move function: Follow up (F), Response (R) Move prospectiveness: Acknowledge (A), Give (G)

Example 2.
This example shows how during the third stage A1OEE reflects the concept of action research against her own work as a teacher.
Author: A1OEE
Title: SEED-Comenius theme conference
“[…]Thus we had—without knowing—completed a full cycle of Action Research. We had acted according to a plan and evaluated it together as “critical friends”. Finally we had ended up developing our action, that is changing the plans as the new cycle began. So Action Research isn’t that peculiar action after all, it is performed in schools also, but one would hope that there would be more time for such spontaneous chatting sessions. AORAE said that Action Research isn’t that special for us Scandinavians. We’ve been able to develop our schools action and curriculum for a long time. the people in central Europe are just departing from their very restricted curriculums. […]”

Example 3.
This example shows how during the third phase a participant reflects the concept of sustainable development against her own school’s curriculum as part of her work for a thesis.
Author: A1OUA
Title: Concept of Sustainable Development ”It is truly important to remember, that Sustainable Development includes ecological, economical and social aspects. I feel like I’ve been able to digest only a small portion of Sustainable Development. Do we in Finland have such learning material that would take notice of all the aspects? I need to re-inspect our school’s Green Flag activity in order to reflect, which aspects are actually catered in it. Although it might also be so that different aspects get different emphasis in different projects. This should be mentioned in the project overview.”

Example 4.
Here the selected excerpts from interviews exemplify how, when asked about what the participation has meant to them, the people involved in the lengthy process of knowledge building reflect different aspects of their identity as knowledge-builders.
#A1OUA: “[…] A0YHA sort of guides probably all of our professionality, but especially I notice that being the case with me […]”
#A1OEE: “[…] there just seems to be not enough time and energy. But on the other hand! […]it [knowledge building] it is a way of escaping into the computer, it’s like a sort of a secret letter companion, the friends there so that I got away and into a whole different set of ideas”.
#A0YHA: “[…] but then, when the five years that I’ve been studying it [own process] and every now and then putting it there […] for example what I proposed in
Toronto, at the moment I [think] that my conception has truly changed. This is something that I experience as an example of an “individual knowledge building”. #A1OUI: “[...] that in a way one’s own thinking, the way of thinking, the sort of knowledge-building and then observing that you could do it, that you could participate with the others and believe in that you can learn and see things from the same level as the others. It has been quite encouraging to learn that you could discuss there. It gave a lot of encouragement.”

#A1HOE: “[...] this work of ours has in my opinion gained respect from our foreign ENSI-partner countries and ... should I say downright admiration! So in that sense we are probably quite advanced in comparison with many of the ENSI-countries.”

Discussion
The research reported here emphasises the value of longer term engagement in cumulative knowledge building where there is a realisation of the activity through professional practice. The implication is that the benefits and goals of cumulative knowledge building need to be reformulated so that participants move from expecting and valuing only obvious, short-term results and benefits towards recognising the value of enduring, paced participation, dialogue and community building. Resolving the issue of the investment of personal time in favour of sustained participation requires new insights and an appreciation of how content, structure and style of discourse can and should be reshaped by the conventions of personal writing and the use of virtual environments. These insights open possibilities for integration and reevaluation of primary, agenda-driven purposes and structures with secondary, collectively and individually meaningful ones. In this way, the technological environment is shaped by the community such that the community reflects types of knowledge building that are critically appraised, collectively validated and relevant to the professional needs of the individuals. These relations between active membership of a knowledge building community and personal professionalism have been described by Engeström (2004) as a profound case of ‘trajectory innovation’—the importation of innovations into an activity system to solve problems and stabilise the system. A strong sense of trust is required. Trust takes time to build, virtually, especially so.

The existing literature emphasises the value of decentralised interaction networks for knowledge building (see, eg, Guzdial, Guzdial & Turns, 2000; Lipponen, 2000). In the setting and time frame that characterised the knowledge building described in this research, the notion of decentralisation has to be questioned. The strong centralisation of the interaction network reported here is an unavoidable result of the urgent need of immediate feedback from the tutor, the central figure. There are situations when expert centralisation is beneficial for knowledge building in professional networks. The structure of message threads in the research reported here shows the importance of direction and focus. The increase in the responsiveness in phase II of the project revealed, through discourse analysis, results from the writing of the community progressively focusing on particular message threads and knowledge building views. Moreover, face-to-face meetings happen in dedicated time. Knowledge building through online
exchange requires a different type of time management and motivation. Typically, rates of participation are higher when there are incentives, for example, with credits in an award-bearing programme where, again, the centralised role of the tutor is important.

In the Finnish ENSI community, the tutor had a prominent central role. However, deeper analysis of centralisation reveals it to be a complex matter, where facilitating, mentoring and the deployment of expertise come to the fore at different times with different actors taking a lead role. A facilitator responds to contributions, and maintains focus and flow in the knowledge building process. This includes creating new views in the database and reacting to participants’ needs and questions. A facilitator is not necessarily a tutor. Often, it is someone who takes it upon his or herself to respond to many of the messages. He or she ‘ends up’ with the role. The incentives for doing this are not always clear, but a desire to celebrate, justify, clarify or consolidate forms of professional practice (as illustrated in Figure 13) may be important. Mentoring is more clearly related to the centralised tutor role—providing the feedback, guidance, reference, etc for the thinking and research of individual participants to advance. Interview responses confirm how important are both facilitation and mentoring for emotional and professional support. All participants develop expertise through their own knowledge building—developing ideas, reporting progress with research, etc. This expertise takes a centralised role when it is deployed proactively for the benefit of others. Expertise can come from any participant, and different individuals will adopt prominent roles at different times. The juxtaposition of the different centralities and roles is a manifestation of the self-organisational properties of the community.

The research revealed a developmental trajectory to cumulative knowledge building, starting with routine exchanges through concept formation to concept application. This gave knowledge building a ‘direction’, partly influenced by tutors and facilitators, but partly something that emerged from the community as illustrated in Figure 13. Messages from early in the trajectory were seldom revisited, although the possibility of doing so was always present. The developmental trajectory evident in this research largely endorses those reported by others, but in some cases, takes them further. For example, Leach (2002) describes six stages starting with ‘newcomer participation’ and ending with ‘transformation and change’. In Leach’s framework, transformation and change is a hypothetical stage, but the long-term nature of the research reported here provides evidence of transformation: one participant went through her many hundreds of notes and consolidated them as part of a doctoral dissertation (Aineslahti, 2009). In her dissertation, Aineslahti gives evidence of how the teachers learnt more mature ways of thinking, and the school implemented more effective means of acting for sustainable development.

In conclusion, this research has demonstrated that:

- A combination of social and technological ‘lenses’ as analytical devises provide a cumulative integrated view of the dynamics of online knowledge building.
• The systematic, incremental, integration of new knowledge with existing knowledge, collaboration and cooperation are important characteristics of online knowledge building.

• Paced participation, dialogue, community building, collective appraisal and developmental trajectory are foundations for long-term benefits in online knowledge building.

• Online knowledge building is likely to be most active when build-on comments arrive quickly, are related to a ‘hot topic’ and have practical benefits to professional practice or help accrue ‘credits’.

• Strongly centralised interaction networks may be as productive as decentralised networks for online knowledge building.

• On-line knowledge building differs profoundly from face-to-face dialogue. Whereas discourse analysis may provide valuable insights into the social and technological elements of knowledge building, its application should be subject to careful methodological scrutiny.

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References


