

INVESTIGATING SOCIO-SPATIAL KNOWLEDGE NETWORKS IN TECHNOLOGICAL LEARNING

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ABSTRACT

This study constitutes part of an ongoing research programme exploring New Zealand dairy farmers' uptake of technological learning (TL), which means the way in which people access information, convert it into useable knowledge, and benefit by it in some way. As yet, no research has explored the ways in which social networks may be important in TL, despite the awareness that social networks may well be significant in information acquisition and distribution. Socio-spatial knowledge networks (SSKNs) is a new methodology designed to investigate individuals' learning, which combines their explanatory cognitive models of the acquisition and use of information with a micro-geographical analysis of the networks of social relationships within which people create and maintain their knowledge. This study reports on outcomes from intensive, semi-structured interviews with and observations of the six farming families involved. To create a fuller contextual picture we located participants' reports of their acquisition and use of information within their perceived environments of trust and risk, following Giddens's (1990) typology of trust and risk in pre-modernity and modernity. Participants were incessant users of interpersonal and print information, seeking advice from numerous different sources, and monitoring their incoming data in the light of their immediate and longer-term strategic needs. We found that participants' information needs are extensive, reflecting their roles as both practitioners and managers, which require making decisions about a variety of topics, the most demanding of which are ones where there are sharply differing points of view. This breadth of information demand is typical within SMEs. The participants showed characteristics of pre-modern, modern and even post-modern society in respect of their use of complex interactional forms, as well as a unique blending of individualistic and communitarian practices and concerns in their professional and personal lives.

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INTRODUCTION

This study extends research into New Zealand dairy farmers' uptake of technological learning (TL) which has provided insights into a number of issues affecting learning in the context of an industry which is actively pursuing productivity improvement. Prior research addressed the way in which particular groups engage in TL, including women and Maori farmers (Hurley & Massey, 1999; Kingi, Kuiper & Clough, 2000; Massey & Hurley, 2001), explored the specific factors relating to small and large farms (Parker, Stantiall, Allen, Hurley, Kuiper, & Massey, 1998; Massey & Hurley, 2001) and looked at changes in the way extension services are being delivered to the industry (Hurley, Parker, & Stantiall, 1997). As yet the study has not explored the ways in which social networks may be important in TL, which refers to the way in which people within firms access information, convert it into useable knowledge, and profit by it in some way.

An important but unanswered question in the literature of TL is the extent to which individuals' interpersonal networks are significant in the various phases and processes implicit in TL. Therefore the impetus for the present study was the desirability of sketching the dimensions of people's interactivity and space, in its broadest manifestations, in the analysis of the acquisition of information, the sensemaking in which people engage as they convert it into knowledge, and their mobilisation of that knowledge in a way that might add value to their businesses and their lives.

One of the challenging features of the study of networks and TL is that much network analytical research into organisational effectiveness has been done in organisations of medium to large size, which are very unlike the small to medium enterprises (SMEs) or micro-enterprises of dairy farmers. SMEs and micro enterprises worldwide also tend to be under-researched in favour of corporate contexts.

The New Zealand dairy farmers' context also has some unique characteristics. These include the family nature of the business, their SME or micro nature, the fact that employees and their families often live on-farm, the rural character of the enterprise, and the rural character of the community within which the business operates.

In this study there intersect issues of place, information getting, trust and risk. Questions of the spatial relationships in access to and use of information are central, but also relevant is trust. Business or personal information is generally acceptable only to the extent that recipients believe they can trust the veracity and motives of the sender.

Yet business users of information also are active managers of risk from a variety of quarters. Many New Zealand dairy farmers are highly geared in a fiscal sense and so tread a fine balance in their management of debt and cash flow. Should they make the wrong decision about investing in seed, cattle feed or fertilisers, should expected rainfall not materialise, or

should sudden changes occur in the currency exchange rate, severe and possibly irretrievable losses can eventuate. For these reasons this study explores localised information getting against a backdrop of conditions of perceived trust and risk.

While learning is often thought of as an individual cognitive activity, it also has relational aspects (Bogenrieder, 2002) in that work and community relationships can encourage or inhibit learning. The dimensions of such relationships are not yet well understood. Social networks are important in acquiring information (Cross, Rice & Parker, 2001) and therefore, we assume, in learning or advice seeking. However, little is understood about how social relationships created by interpersonal processes influence who is sought for different kinds of information. As Cross, Borgatti and Parker (2001) observe, "Given the centrality of social interaction as a vehicle for both knowledge creation and use, it is surprising that we know so little about how seeking information from other people at work results in actionable knowledge" (p. 215).

LITERATURE REVIEW

Mapping socio-spatial knowledge networks (SSKNs) is a new methodology identified as a valuable way of investigating people's learning about community health facilities and potentially increasing their knowledge of good health outcomes (Cravey, Washburn, Gesler, Arcury & Skelly, 2001; Skelly, Arcury, Gesler, Cravey, Dougherty, Washburn & Nash, 2002). A SSKN is a combination of people's explanatory cognitive models of how they acquire and use information, plus a micro-geographical analysis of the networks of social relationships within which they create and maintain their information. Despite its potential to add to knowledge of how social networks operate, or to the processes of individual and organisational learning, SSKN does not yet appear to have been applied to organisational learning.

The SSKN literature, in its earliest manifestations, has focused on specific knowledge, specifically, the knowledge about diabetes possessed by at-risk individuals in a rural community, which provides a precise focus for research. For example, it was easy for those researchers to assess the accuracy of their respondents' views, who could be either right or wrong or partially so in their knowledge of specific topics, such as what is diabetes and what is their personal risk in terms of likelihood of contracting it. The aim of the present study was exploratory in character, aiming to establish the appropriateness of the SSKN approach within the context of technological learning in SMEs, to obtain some insights into the nature of the spatial and interpersonal dimensions of information access and use.

In order to sketch in a broader context for this study, we employed Giddens' (1990) variables of lived environment, trust and risk, which he addresses in his discussion of pre-modern and modern societies, along with his assessment of indications of post-modernity. Trust has to do with the emotional (rather than intellectual) experience of ontological security, and the sense that a person is not significantly at risk in their everyday transactions and experiences with others. More specifically, a person awards trust to another, when on the basis of experience or authority (but especially experience) there is evidence that the other has benign intentions towards oneself and is, essentially, not out to profit at one's expense.

Giddens addressed issues of trust and risk in pre-modernity and modernity in this way.

Figure 1: Trust and Risk in Pre-modernity and Modernity

(Adapted from Giddens, 1990, p. 102).

PREMODERN	MODERN
Context of Trust	Context of Trust
1. Trust is based on localised relationships	1. Trust relations are grounded in abstract systems
2. Kinship relations stabilise social ties	2. Social ties are stabilised by personal relationships of friendship or sexual intimacy
3. Individuals are grounded in local community	3. Human relations rely on the operation of complex (often international) abstract systems (e.g., communications, travel or economic systems)
4. Tradition connects the present with the past	4. People are more strongly oriented to the future than the past
Context of Risk	Context of Risk
1. Nature poses immediate threats, e.g., from diseases, climatic change, etc.	1. The conditions of modern social life (rather than nature) present the most significant risks and dangers
2. Human violence is close at hand, e.g., from marauding armies or local warlords	2. Industrialisation of war poses the major form of potential violence
3. Malign magical or religious forces create risk and threat.	3. The secularised experience of perceived meaninglessness creates anomie and psychological vulnerability.

RESEARCH AIM

The aim was to explore the place of social networks in farmers' and their immediate associates' TL using the SSKN approach, though as modified for the environment of the current study, which was of farmers in the context of their families and businesses. This was in contrast to the earlier studies, which used this methodology with non-farming individuals in rural and semi-rural communities. We wished to assess whether using SSKNs assists us to better understand the processes whereby New Zealand dairy farmers obtain and employ information. In addition, we sought a sense of whether SSKNs are modified by print media or Internet sources of knowledge, as well as some insights into whether an understanding of socio-spatial knowledge networks can help to inform the design of technological knowledge systems.

The current SSKN literature focuses on the spatial relationships of respondents, producing a micro-geographical analysis of interpersonal information-transfer. In the present study, while not wanting to neglect the closest assessment of spatial nodes in individuals' access to information, we wanted as well to explore dimensions of interpersonal contact beyond face to face, such as the role of telephone, fax and e-mail.

We were also interested in exploring the connection between advice seeking and other forms of acquisition of information. The term advice seeking is generally associated with implications that by this means people obtain their information in an assertive, intelligent way. Not included in advice seeking is any serendipitous or passive acquisition of information. Yet if advice seeking has to do with "pull factors" of going out and actively getting information, then to complete the picture we needed to include the "push" factors

whereby information more or less just arrives - such as scanning the environment in an unstructured or semi-structured way, happening to be in the right place at the right time, or, in a generalised sense, building a cognitive structure of knowledge that just might be useful at some future point.

Part of the rationale for a study of this nature is the awareness that innovation often is founded on informal means of communication (Pred, 1977). Although this study is not of innovation as such, the search for best (or at least better) practice in fact runs through the everyday lives of our participants, who were continually alert to the possibility of useful new knowledge that might be in their environment or that they might seek out in some way. Because this study has to do with the everyday interactions among people who often know one another well, it is also necessarily interested in issues of tacit knowledge and the informal means whereby people share their information in ways that others can access. In contrast to explicit knowledge, tacit knowledge is not codified in any formal source such as a book or computer file, but reflects individual uniqueness and therefore is personal to the individual and idiosyncratic in nature (Polanyi, 1962).

The SSKN approach should furnish a preliminary indication of where, for any given individual operating within their professional role, the strategic locations within a local area help to shape and define the interactions and forms of communication practised by individuals. SSKNs bring together and try to comprehensively depict (a) individuals' cognitive maps, meaning a personal depiction of how people construct their own understanding of their role in their professional environments, along with (b) a micro-geographical plan of relevant local or distant sites visited by the individual in actual or virtual form that are meaningful to their professional role, as well as (c) a set of individual activities that together embody people's maintenance of information flow both from and to their environment.

METHODOLOGY

This research aimed to attune itself to local particularities by using a research method closely grounded in local geographical and other contextual aspects, with the goal of determining key facilitators of learning and the factors that validate and sustain it. The SSKN methodology proceeds by the following steps:

1. Scope the physical environment
2. Research local issues and concerns
3. Meet and recruit or confirm research participants in their research function
4. Map each respondent's networks of significant interpersonal contacts
5. Create a listing of place inventory information
6. Produce maps and network nodes of the learning landscape germane to the issues being explored or of particular relevance to respondents.

In this study the researchers used a slightly different approach, primarily because of the understanding we already had of the environment for dairy farmers in New Zealand. In a previous phase of the project we had asked different groups of industry representatives to identify and map the industry's key institutions. We had also asked this particular group of farmers to identify their sources of information. These exercises provided the researchers

with a 'scoping' of the physical environment that was far more detailed than would have been the case if we had simply followed the methodology described above.

In addition, we were committed to maximising the opportunities for us to understand the particular context of the research subjects, by selecting interviewees from the farmers who had been visited in a previous phase of the project. We did not visit all of those involved in the previous phase as, while we had previously been interested in exploring the differences in TL due to size of farm and ownership structure, here our focus was on the relationship between their personal information networks and their geographical location.

As a consequence we selected a group of farmers who were in a reasonably close geographical area. This was in the North Island of New Zealand, an area that is traditionally regarded as being highly suitable for dairying. This group of seven farmers (mostly men, although some couples were interviewed) included one farm that could be described as large, three that were medium in size and three which were small (as defined for the purpose of this project). All participants were owner operators rather than sharemilkers (i.e., an employee with some ownership). Interviews, which were undertaken on-site, were semi-structured, typically lasted about 90 minutes, and aimed to draw out participants sufficiently so they could to some extent reframe the discussion in their own way.

In addition to the interviews, the researchers visited the nearby towns that were mentioned, to gain a sense of the geographical context within which the farmers were operating when they identified their sources of information. Following the SSKN methodology the respondents' significant interpersonal contacts were summarised, a place inventory was compiled and maps of the individuals' SSKNs (including network nodes) were drawn.

RESULTS AND DISCUSSION

New Zealand farmers operate in a context that is rich in the number of sources of information available to them, and where farmers are supported by the industry to increase their level of knowledge, in the context of farm-level and industry-level gains. Historically they have also had an institutional infrastructure to ensure this can occur, primarily through the provision of farm advisors through the farm extension service supplied by consultancy officers (this is still in existence, but is gradually becoming less comprehensive). Information is available nationally, regionally and locally, although this is not uniform across the whole country, with some areas having a denser concentration of information sources for different types of farming. Even in the area studied here (which would be described as valuable dairying land) there is some difference in its use. For example, Matamata (the nearest township for one respondent) is predominantly an agricultural service centre (servicing the dairy and bloodstock industries), while Whakatane (the nearest township for two respondents) has the flavour of a town where tourism is as important as agriculture. The differences in land use may mean that some farmers have access to a broader range of information sources than others.

Another important context-setting factor is that unlike the individuals seeking information on diabetes (Skelly, Arcury, Gesler, Cravey, Dougherty, Washburn & Nash, 2002), farmers' information needs are extensive, because of their roles both as practitioners and managers.

They need to make decisions about a range of topics, including some (though relatively few) where there are known 'correct' answers, but many others where experts may disagree and there may be many sharply differing points of view. This situation (where the owner needs to know about a wide range of topics) is typical of the context of SMEs.

A third issue is that farmers typically run their businesses from home, often literally from the dining room table. One of the consequences of the situation is that personal and business environments and their associated networks overlap and intermesh in a variety of different ways. The same individual who is helping you to select appropriate grass fertiliser for the forthcoming spring may well be the same person with whom you interact at church or on the committee of the nearby squash club. This means that there are many more information sources potentially available to the people operating within these contexts. The type of sources will also be highly varied. For example, a social function at the local school may provide the farmer with an opportunity to get information informally about a topic of concern (e.g., what sort of grass seed is most suitable for a particular situation), that is as 'correct' as the information that would be available from a seed merchant (and in fact may have higher credibility because the salesman is seen as "pushing his own barrow").

This is consistent with Lagendijk's (2001) statement that, "it is the specific social fabric that should be the starting point, not just the mapping of distances" [in a network]. This is true, we believe, in a general sense, but problems of level of analysis are implied. The unit of analysis needs to be more precisely stated than "the social fabric," and in the present study we found that it was important to have the individual at the centre of our enquiry and to explore that person within their lived context and as both recipient and source of information flows.

Below we attempt to assess the place of how well SSKNs appear to contribute to organisational learning, using the individual as the starting point. In line with the SSKN approach, the current study set out to be closely attuned to local socio-environmental features, with the aim of determining the extent to which local technological learning is grounded in networks of family, business and community contexts. Following Cross, Borgatti and Parker's (2001) observation that "it is surprising that we know so little about how seeking information from other people at work results in actionable knowledge" (p. 215), we focus specifically on the way in which participants access information, attempt to make sense of it within their own contexts and in the light of their perceived needs, and either store it for eventual use or make a decision based on it.

All participants were conscious absorbers and users of information, though in very different ways. These differences reflected the people they were, how they perceived their farming and business role, as well as their skills and attributes in handling information. They also obtained their information from a wide range of sources. Some information sources are deliberately selected by the individual, from a range of possible options (e.g., veterinarians are a case in point, selected for their scientific expertise). However the respondents also identified as sources of information, individuals who had sought the farmer out (e.g. fertiliser salespeople).

In addition to the information collected through face to face contact with others, the participants collected a considerable amount of information from printed material such as newspapers and magazines, advertising material, (especially that which arrives unsolicited in

their mail boxes), and other media, such as radio, television and the Internet (which is highly variable in its usefulness, depending on the broadband access that happens to be available). Amongst the participants there was a high degree of commonality between the types of information sources and the activity spaces identified. For example, most identified their local rural supplies shop (either RD1 or Farmlands) as an important place that was visited frequently, and where information about a broad range of topics could often be gained (from the sales staff, but on occasion from other customers).

After listing the places and people that make up their knowledge networks, the participants were able to identify their top three sources of information, and describe the way in which they processed the information. Here it was obvious that most were busy, and as a result they were primarily focussed on their immediate information needs (“I just throw anything out that I’m not going to use”). Despite this strong awareness of some needs as being more urgent than others, it was also apparent that participants realised the value of constantly staying up to date with a kaleidoscope of perspectives on farming practice, their industry, including its impending trends, and what their friends and acquaintances and family in dairy farming were up to.

Thus, scanning the environment (e.g., Beal, 2000, Howell & Shea, 2001) was seen as essential by all participants, though it was practised to a lesser or greater level of sophistication. The purpose of this scanning was to build expertise in a general sense as well as to stay in touch with their communities, whether immediate, in the sense of the nearest few farms around, or intermediate, in the sense of across the district or province.

In identifying a number of different sources of information, it was clear that participants seemed to use a number of information sources on the same topic, either in an attempt to confirm the correctness of some information (by drawing upon the different experiences of individuals) or to adapt general information to their specific location and situation. For example, several of the participants were enthusiastic users of the Internet, and received a great deal of information from this source. However, they tended to want to talk to a local user before implementing it. It was also evident that participants carefully weigh up the quality of the information they receive according to the perceived motives of the information source.

Hence, the reputation in their community of the various salespeople is important as a means of assessing just how trustworthy their information might be. In particular, our participants voiced especial concerns about objectivity when a salesperson was remunerated on a commission basis, as this was feared to reduce the quality of their advice even further. Individuals whom they perceived to have practical experience (i.e., had actually operated their own farm) were seen as more credible.

In terms of the geographical extent of the participants’ networks, it was clear that as well as the local and regional boundaries that we expected to observe, each participant also had a sense of locality that was specific to the farmer. For example, one participant made active use of the information gained from farmers who were his neighbours on a previous farm. There was also an identifiable time dimension to the SSKNs that were described to us, which is not surprising given the seasonal nature of the farming business and the way in which this affects the regularity with which farmers were in contact with individuals such as stock agents.

However, while the participants could describe their networks in terms of the individual components (both individual sources of information and activity spaces), they clearly had a sense of the need to distinguish between information from different sources. In particular, they often made reference to issues of relevance and veracity of the information that they obtained from print and interpersonal sources. They were accustomed to scrutinising what they read and heard in the light of its perceived qualities of trustworthiness.

As a means of reflecting on our interviews and to focus more precisely on the issues of trust and risk that condition the acceptance and use of information, we sought to estimate the relative weighting of the elements of pre-modernity and modernity in our participants' life experience, in line with Giddens (1990) (Fig 1 above). Our assessments of respondents' relative place in pre-modernist or modernist systems, based on interviews and observations, were along the following lines:

Figure 2: Assessment of Pre-modernity and Modernity in Respondents' Lives

PREMODERN	MODERN
Context of Trust	Context of Trust
1. Localised relationships: 60%	Trust in abstract systems: 40%
2. Kinship relations: 30%	Personal relationships: 70%
3. Local community: 50%	Abstract systems: 50%
4. Tradition of past informing present: 40%	Future orientation: 60%
Indications of pre-modernity: 45%	Indications of modernity: 55%
Context of Risk	Context of Risk
1. Threat from nature: 70%	Threat from conditions of modernity: 30%
2. Human violence nearby: 10%	Industrialisation of war: 90%
3. Malign magical forces: 10%	Perceived individual meaninglessness: 90%
Indications of pre-modernity: 30%	Indications of modernity: 70%

This allocation of percentages is by no means meant to imply exactitude either in description or measurement of variables, or in analysis of results, but is meant as a best guess, based on interviews and observation, serving an indicative purpose of locating respondents within a pre-modernist and modernist framework of trust and risk. In respect of trust, modernity is only somewhat stronger than pre-modernity. For risk, modernity is much more pervasive. Nevertheless, especially for issues of trust, pre-modernism is still a characteristic of

respondents' lives and is not cancelled out by the presence of modernist circumstances. This generalised assessment is meant more to signal the conditions under which we believe respondents in this study acquire and assess their information, make sense of it, construct their business and social realities, and make their investment decisions.

CONCLUSIONS

This study has been an attempt to map the dimensions of our participants' individual informational landscapes with the aim of seeing if any significant commonalities emerged that would enlarge our understanding of the place of information getting and giving in their professional lives. The goal was to employ a spatial perspective, out of an awareness that geographical patterns and flows of information had not in previous studies, been assessed.

We feel some concern at the dichotomous nature of the comparisons some commentators have drawn: pre-modern versus modern, modern versus post-modern, as if a polity, community or person can exist only in one mode at any one time. In fact our participants construct their own reality, which may have characteristics of all of pre-modern, modern and post-modern, depending on what facets of their lives they are experiencing. If post-modernity is institutionally complex (Giddens, 1990) then the evidence suggests that these dairy farmers work within multiple layers of institutional forms, ranging from interactions with consulting officers paid from farmer levies, with members of veterinary practices, farm discussion groups, seed and animal remedy merchants, groups that exist to lobby government, quality associations and others, all of whom influence their economic and social sustenance.

Giddens (1990) also speculates that one of the characteristics of a post-modern society will be that it has transcended capitalism in its evolution into something like socialism, (though it will not be like socialist states of today). These dairy farmers have in a real sense reconfigured into an evolutionary form beyond capitalism. While they remain part of a capitalist system, they also celebrate the fact that they are not in competition, hence can and do actively collaborate with one another. (The absence of competition stems from the fact that nearly all New Zealand milk production is bought by Fonterra, a single-desk purchaser and marketer of New Zealand milk products, with farmers all receiving the same per-kilogram payout.)

At a practical level this collaboration includes on-farm activities such as collectively making silage or owning in common seldom-used items of farm machinery such as baling equipment or stump grinders. More crucially, an absence of capitalistic style competition means farmers know they receive material and social benefits from activities such as running and attending on-farm discussion groups, financing and holding staff training activities on a district-wide basis, as well as being in constant communication with one another in a loose but effective system of mutual advice-giving and support.

Further characteristics of post-modernity are advanced by Giddens (1990) and Held (1987) as a proliferation of new forms of local organisation, along with the emergence of new forms of democratic involvement in local associations and in the workplace. Certainly these farmers in many ways model the cliché of the rugged individualist, and they are attracted to the industry less for its fiscal rewards, which are uncertain, than for the lifestyle and the freedom to make their own decisions. Yet their individuality is tempered by their sense of give and take, and of

having a responsibility to the collectivity. This is a dynamic of individual ownership of farm and decisions, with no form of government support or subsidy in a fiscal sense, yet all within a pervasive culture where mutual support is expected and normal.

The debate on pre-modernity, modernity and post-modernity (e.g., Bell, 1974, Habermas, 1987, Vattimo, 1988) sometimes seems to proceed as if we are to expect a tidy linear progression from pre to modern to post. For example, Giddens (1990, p. 108) believes that “the primacy of place in pre-modern settings has been largely destroyed by disembedding and time-space distanciation. Place has become phantasmagoric because the structures by means of which it is constituted are no longer locally organised.”

However, observation of these farmers’ lives instead implied a circularity or looping effect, whereby what we have here described as their elements of post-modernity plus modernity, in no way contradict the pre-modern characteristics of their lives, and even reinforce them. For example, the robust forms of bottom-up interaction and information sharing, whether by face to face discussion groups, phone, fax, email or via websites, underpin and recreate in new ways what Giddens describes as pre-modernity, fostering quasi-kinship relationships within an active community that are both an end in themselves, as well as being instrumental in helping individuals to achieve their economic goals and meet their social needs.

Further, these farmers must still plan and work within a pre-modern environment of risk, constantly waging war against endemic diseases such as mastitis, making decisions to try to mitigate the vagaries of climatic threats such as global warming, and always managing and monitoring effects on soil health, grass growth and animal and human health of fertilisers such as phosphates.

The present study set out to explore characteristics of information getting, knowledge creation and sense making within localised venues of networks and community. We found that farmers sieve their incoming data through a fine mesh of perceived credibility and trust, and do so against a backdrop of substantial risk of both financial and environmental dimensions. We found community implies both pre-modern in its grounding in the local, as well as modern in its intimate association with international markets, *inter alia*, but may also be seen as containing elements of post-modernity in its employment of complex interactional forms and its blending of individualistic and communitarian.

In some quarters eyebrows may be raised at a study of dairy farmers, but Karl Weick once argued that it makes more sense to study unusual or atypical enterprises, as researching the same old corporate capitalist structures, at a certain point, tends to become banal and unproductive. In similar vein is the Saatchi and Saatchi observation (e.g., *Transforming clients’ businesses*, n.d.) that the important developments occur at the edge, because whereas the centre turns into the dead centre, a zone of safety and predictability, it is at the edge that innovation and the more interesting challenges to established practice may be found. The results of this study are sufficiently encouraging as to suggest that further location-based studies of individuals’ learning in their actual and virtual communities, whether close at hand or dispersed, are warranted.

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