Making new connections: interactive network graph to enhance sharing opportunities for TEL practice

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Abstract

This focus of this preliminary study is located in continuing professional development of university-based teaching practitioners. The study reports on the design of a prototype tool, an interactive visual network diagram. The purpose of the diagram is to enhance the sharing of technology-enhanced learning (TEL) practice between teaching practitioners. It enables them to identify fellow practitioners who use a particular technology in their teaching for problem-solving and sharing TEL practice. Design principles combine two theoretical approaches: Communities of Practice and Social Network Analysis. This paper argues that the complementarity nature (Cummings and van Zee 2005; Wenger, Trayner and de Laat 2011) of the two frameworks can offer good design principles for the prototype diagram to share TEL practice. For a system to identify potential connections made between professionals with the same topic of interest (a particular technology) within a wider domain (teaching practice), concepts from both theories are needed. Such a visual representation would need utilise the concept of nodes and ties from Social Network Analysis, extend domain of interest to represent sub-domains from communities of practice as well as signalling potential connections to be made.

Findings of the preliminary stage of design-based research methodology included the potential usefulness of the prototype to identify peers' help for solving a problem, getting ideas on how people use a particular technology, sharing teaching practice and also practical tips for introducing the technology to students. Procedures to be supported included populating the diagram with data, maintaining the currency of data, user interactions such as viewing the visualisation, selecting relevant nodes/links, contacting selected contacts or downloading/exporting data. Another key feature of the diagram should be to visualise the potential value of future links to be made for the user. Participants also reported challenges of such a visual prototype. Firstly, whether practitioners would actually contact those whom they do not yet know and secondly, how would practitioners become aware of the diagram's existence? The paper concludes with implications to theory and practice, pointing towards the strength of combining two theoretical approaches, Social Network Analysis or Communities of Practice, in exploring the informal sharing of practice in organisations.

1. Introduction

Academic staff who would like to innovate their teaching using technology are likely to need to seek answers to their practical questions or share practice in their discipline. The availability of accessible colleagues, or 'near peers', was found as one of the most influential factors in academic practitioners' adoption of technologies (Prescott, 2013). Staff may be using various technologies in classroom sessions. There may not always be central, institutional support for all these technologies. There may not always be an accessible 'near peer'. Practitioners may need to seek further support from their institutional colleagues, or from beyond their disciplinary boundary (Sherer, Shea and Kristensen, 2003). How could practitioners create new connections in the same institution who use the same kind of learning technology for problem-solving and sharing? This preliminary study reports on the first stages of design of a prototype tool, an interactive network graph, which aiming to achieve exactly this.

2. Literature review

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2.1 Theoretical framework: Communities of Practice and Social Network Analysis

Informal social learning between peers is paramount to facilitate the sharing of professional practice (Boud and Hager 2012; Levin and Cross, 2004). Communities of practice (Wenger 1999) and social network analysis (Borgatti et al., n.d.) are two useful frameworks of social learning. This paper argues that the complementary nature (Cummings and van Zee 2005; Wenger, Trayner and de Laat 2011) of the two frameworks can offer good design principles for the prototype diagram to share TEL practice.

A community of practice enables 'collective learning in a shared domain' (Wenger, 1999). Communities of practice are seen as important in the development of departmental (or of any other institutional unit) learning communities in an education context (Cox 2001; Wildman et al, 2000). A key characteristic of communities of practice is interaction and learning together (Wenger-Trayner & Wenger-Trayner, 2015). This presumes that practitioners will know each other, although also appreciates that such communities are dynamic constructs with members joining in and out constantly. From an organisational perspective, a useful conceptualisation is to see parallel communities as a 'constellation of communities of practice, each taking care of a specific aspect of the competence that the organization needs' (Wenger-Trayner & Wenger-Trayner, 2015, p.4). Wenger's levels of community participation (1999) distinguishes core, active or peripheral members. There are two challenges of this theorisation. The first concerns those practitioners who are not yet members of the community. One value of such informal communities comes from connecting local pockets of expertise and isolated professionals (Sherer, Shea & Kristensen 2003; Wenger, McDermott & Snyder, 2002). How are they able to identify those who share the same domain(s) of interest, so that can make steps towards joining the community? Or vice versa, how can current members identify potential members, especially when they are not immediately in their nearest institutional location? The second challenge concerns the way constellations of communities can be represented, some of which may include overlapping or concentric relationships. For instance, there can be a number of communities of practice centred around the use of particular technologies in teaching, but also generally a community of practice of teaching practitioners at an institution who connect with each other to share teaching practice. One of the shortcomings of this theory for the purpose of enhancing sharing of TEL practice in an institution is that a significant group, that of the potential members (or the access route to potential members), is not included. This is where Social Network Analysis could usefully be used to enhance representations of constellations of communities of practice.

Social Network Analysis (SNA) focuses on the concept of networks examining the 'set of connections between people to solve problems, share knowledge and make further connections' (Wenger, Trayner and de Laat 2011, p.9). An advantage of visual mapping of networks is that they not only show the current connections but also signal the potential ties to be made. Another useful concept of SNA is the volume and distance of ties between nodes. Weak ties (Granovetter, 1973) which connect local sub-networks are essential for innovation and the flow of new ideas to flourish (Wenger, McDermott and Snyder 2002). In a typical SNA network graph, the ego networks of practitioners would be represented: those practitioners who know and talk to each other. The shortcoming of SNA is that only the nodes and their connections are represented (Wenger, Trayner and de Laat, 2011). The shared domain of interest, 'what people talk about', is missing from such analysis (de Laat and Schreurs, 2013). Representing the domains of practitioners, i.e. the technologies about which they share their practice, is essential for this study. Only then can practitioners identify potential ties-to-be-made with other practitioners, increasing the serendipity of new connections (de Laat and Schreurs, 2013). A potential question is to what extent ego-networks is a necessary or practical concept for this prototype's purpose. In an organisational context the graph needs to be scalable. This leads to considering a visual prototype that harnesses the complementary nature of both, the communities of practice and SNA, theories (Cummings & van Zee, 2005; Wenger, Trayner and de Laat, 2011). The Network Awareness Tool by de Laat (n.d.) is such an example: it represents social networks between people and their domains of interest.

The proposed tool builds on this development from two perspectives. The visual representation focuses on:
- the shared domains between practitioners (representing both technology-practitioner and practitioner-practitioner connections);
- signalling potential connections, rather than visualising current network ties or ego-networks.

Thus, in a cognitive walkthrough, a P1 practitioner working with X technology could identify from the graph any other practitioner who is working with technology X (e.g. P2). If they did not know P2 personally, they could look for any other P connected to P2 (e.g. P3) whom they knew, and either connect and contact P2 directly, or contact them via P3 whom they already knew. A 'pure' SNA graph would only reveal connections

between P2 and P3, so P1 would not be able to say who uses technology X. A community of practice -type representation of Technology X may not represent that P3 is a user of Technology X, and therefore a potential member to join this community of practice. In the proposed prototype, the central attention is paid to potential, rather than current connections. This is where it builds on the existing theory that is a complementary combination of communities of practice and SNA. The prototype is not meant to serve as a tool for network analysis or replace face-to-face connections. Its sole purpose is to help locate practitioners with the same TEL interest, 'giv[ing] rise to unexpected connections' (Wenger, Trayner and de Laat 2011, p.12) for the benefit of learning from each other in the same domain.

2.2 Why an interactive visual diagram?

Social Network Analysis has long benefited from visualisation but mainly for the purpose of analysis from a research perspective (Borgatti et al., n.d.). With this prototype, the main intended beneficiaries of the visualisation would be practitioners. Advantages of such a visualisation include:

- Signalling actual and potential connections.
- Ability to represent multiple parallel sub-networks/communities of practice in one place;
- Extra meaning expressed by the visual mode (e.g. by location, colour or size) (Engelhardt, 2002);
- Potentially more inferences can be generated from visual than from textual resources (Passey, 2014 quoting Kühl, Scheiter, Gerjets & Gemballa, 2011).
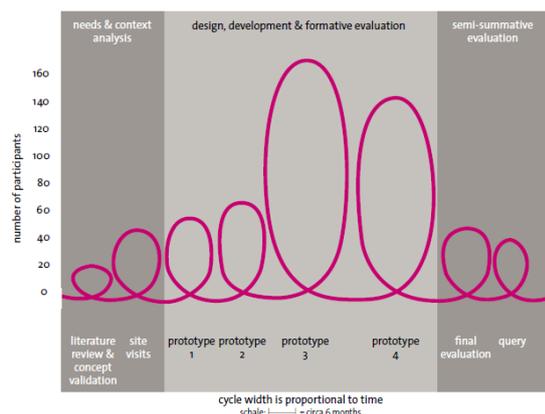
3. Research design

3.1 Researcher position and research context

Whilst SNA is concerned with network properties as a whole, predicting individual behaviour (Borgatti et al., n.d.), Wenger, Trayner and de Laat argue (2011) that the value of networks depends on an individual to 'act as responsible nodes and evaluate the relevance of information flows' (p.11). This focus on individual agency (Bhaskar 1993) is used as an epistemological position. I am a learning technologist at a central university unit with a role in facilitating one or more informal TEL networks across the institution. Internal research with university staff on their TEL training needs (Bunyan, 2015) found that staff would like to benefit from more specialised sub-networks for the purpose of problem-solving and sharing TEL practice. Staff were not sure who uses what technology, if they were located beyond one's own local department. Such more focused sub-groups or networks would be more preferable than having to contact the existing mailing lists of larger networks. It was thought that a visualisation network diagram could stimulate such smaller sub-networks (or sub-domains).

3.2 Methodology: design-based research

As the purpose of this small-scale study was to design a prototype diagram of TEL practitioners and their shared (sub)domains of interest, design-based research was considered ideal (Alghamdi and Li, 2013). A key benefit of design-based research is that the reusable design principles contribute to both theory and practice (Amiel and Reeves, 2008). The methodology is an iterative process with 3 main cycles: 1) needs analysis and preliminary research; 2) development including further iterative cycles with formative evaluation; and 3) final evaluation (see Figure 1). Within the timescale of this study, cycle 1 was conducted yielding the design of prototype1.

Figure 1 Cycles of design-based research (McKenney, 2001 diagram from Plomp & Nieveen, 2013, p.18)

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Purposive sampling (Cousin, 2009) was used because it was deemed most useful to select participants who had a particular expertise in relation to the study. Selected academic practitioners (n=2) were all teaching active TEL users; educational developers (n=8) were selected because of their role in promoting similar communities of practice and their knowledge of informal learning communities. Following ethical approval, informed consent was gained from participants. No problems in terms of anonymity and confidentiality materialised. The research questions were formulated according to van den Akker's (1999) guidance for design-based research:
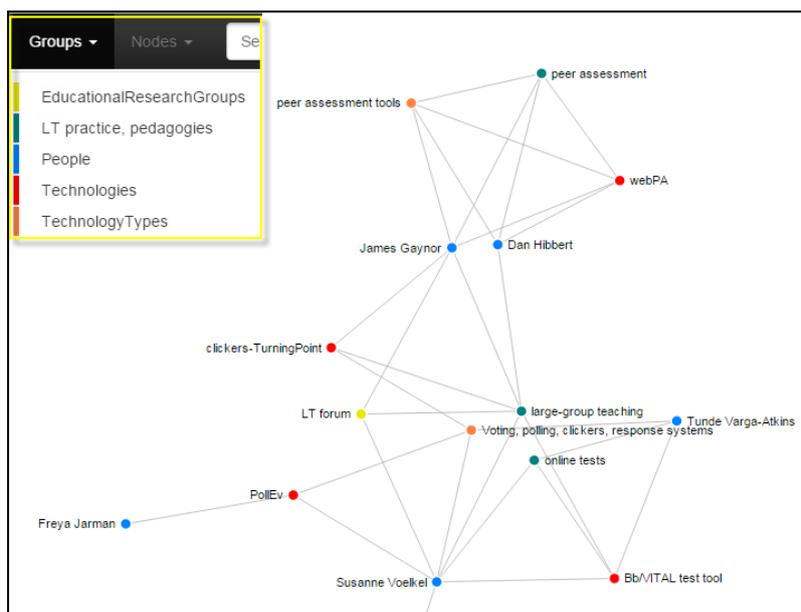
- What characteristics should the prototype have?
- What procedures should it allow?
- What is the perceived need for such a visual network diagram?

It was essential for the participants to interact with the prototype (Figure 2). The interview took place in front of a computer so that participants could comment on its relevance and features (Plomp & Nieveen, 2013). Three interviews up to 60 minutes were conducted, two individual and a group, audio-recorded and transcribed. The decision to conduct a group interview was for pragmatic reasons: it coincided with a group meeting. The interview transcripts were analysed. Desired features of the prototype were summarised using content analysis (Cohen, Manion and Morrison, 2001), helping to confirm the appropriateness of design principles. The reasons given for the suggested features by participants were analysed using narrative analysis (Cortazzi, 2001). This ensured a better understanding of the rationale for these principles for practitioners' practice.

4. The study: the application and the interview process

The study built on an existing application designed at my institution by a programmer. The Network Builder application allows users to visualise networks using SNA concepts. A key difference is that users can define what is represented; nodes can be people, domains, groups or networks. This made it possible to represent staff and their TEL interests. The purpose of the interview method was to elicit the ideal features of a visual network diagram so that the design principles of the prototype could be outlined. Figure 2 demonstrates the interactive diagram used to aid the interview. Nodes and sub-domains were defined as 'Groups', depicted as colour-coded circles: Blue: staff members (Practitioners=P); Orange: domains (Technology-Types=TT) e.g. voting, polling, clickers etc.; Red: particular sub-domains (Technology=T) e.g. Polleverywhere, an example technology belonging to the domain of voting, clickers, polling.

Figure 2: The interactive network graph: clicking on a node would display its linked nodes only

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Blue-red (people-technologies) links represented practitioners using a particular technology or type of technology (blue-orange), and a red-orange link represented technologies that belonged to a certain group of technology. For instance, there are many types of voting systems (Polleverywhere, Socrative etc.). Only a few illustrative nodes and links were created; the diagram was not all-inclusive. The exploration of pedagogies and educational research groups (green, yellow) is outside the scope of this paper. The first iteration of prototype design focused on helping staff identify communities around particular learning technologies/types. So what did participants think about the suggested characteristics and need for this prototype? The next section will detail such findings.

5 Findings: Prototype design principles

Findings are organised to summarise the characteristics and procedures suggested for the prototype, and its perceived need and usefulness.

Characteristics and procedures

Participants agreed that the diagram would need to be easy and simple to use, searchable and offer a way to search synonyms for the same technologies. It should also be possible to simplify the visualisation if the amount of data gets too complex. Procedures to be supported included populating the diagram with data, maintaining the currency of data, user interactions such as viewing the visualisation, selecting relevant nodes/links, contacting selected contacts or downloading/exporting data. Another key feature of the diagram should be to visualise the potential value of future links to be made for the user. That is, if someone searches for users of Technology X to solve problems or share practice, out of the possible N number of links, which one would be worth making? Is it their nearest disciplinary/departmental peer, someone they know, or THE expert of Technology X at the institution, or hubs (well-connected practitioners)? Accordingly, practitioner nodes or links could signal the role, proximity (e.g. sociomapping developed by Bahbouh quoted in Hoschl n.d.), level of expertise (expert/user/interested), collaborative aims or publication status in X. But, whether the potential value of these characteristics would actualise would need to be further investigated.

5.2 Perceived need and usefulness

5.2.1 When/why useful?

The consulted practitioners were both enthusiasts of teaching, and were also open to TEL-innovations, having presented a number of their teaching innovations at local and national conferences. To give a flavour of their perceived need and usefulness of the diagram, their comments are presented in two participant profiles (names have been changed). John is a facilitator of a departmental research group. He 'often ha[s] a situation thinking of doing something [TEL innovation] or running into a problem'. This is why he thinks the diagram would be useful in a number of contexts:

- asking others about solving a problem with a particular technology;

- getting ideas on how people use a particular technology/type;
- sharing teaching practice and also practical tips for introducing it to students.

John listed a number of methods that he would currently rely on, based on similar scenarios. These ranged from asking people he bumped into directly or whom he thought might be using this technology. He characterised this as 'fishing in the blind'. Going to the central TEL support team, or turning to a disciplinary national discussion mailing list were also options. John, although he was member of at least two institutional networks, an e-learning network and their faculty staff mailing list, did not feel comfortable sending people with an email request for help if the email went out to 300+ people. He felt that people do already get many emails. John was positive with regards to the diagram as he had clearly experienced a need for a similar system in the past.

Sally facilitates an informal community of teaching enthusiasts across the university. She used to jump at TEL innovations with more speed in the past. She has a more cautious attitude to adopting new technologies, weighing up all its potential challenges. From a personal perspective, she felt that the diagram would be less useful to her at this stage as she is not thinking in 'dabbling in anything' right now. She felt that maintaining a diagram would be a lot of investment, whereas she could just email people on her community mailing list to find out information concerning a particular technology. Sally did consider that the diagram would be more useful to those who are not the 'core' enthusiasts in teaching but who want to try out something or in the process of implementing new TEL practice. Indeed, such colleagues are more likely to turn to the local/departmental teaching enthusiasts and be less open to contacting colleagues outside the discipline for support. Another scenario in which Sally felt the diagram would be useful was if she knew Practitioner Y and that they were just adopting wikis, but did not know what other technologies Y may also be using in their teaching? The perceptions of the consulted educational developer group were similar, recognising the potential need for the diagram, whilst also identifying some challenges. These will be presented in the next section.

5.2.2 Two challenges

Various participants, both practitioners and educational developers, referred to two challenges of the prototype:

- Would practitioners actually contact those whom they don't know?
- How would practitioners come across the diagram?

Taking the first challenge, participants presumed that the diagram would only present those practitioners who were happy to be contacted. This study's participants were slightly divided, some were happy to email unknown contacts if they had an urgent need, others preferred to go via an intermediary contact whom they already knew. Some proposed that the 'perceived kindness' (Clegg and Rowland 2010) of the future contact could be one consideration deciding which practitioner to contact from those selected. The second challenge concerned how easily users could find out about and locate the diagram. The paradox is that practitioners less enthusiastic about teaching are also less likely to stumble across it on their own, without the prompt of their more teaching-oriented colleagues. This is a familiar tension for academics between their parallel disciplinary research and teaching communities of practice (James 2007). For staff at the university of this study, there are just too many disparate teaching-related resources online: "iLearn, iTeach, My[XXXX], many people just don't know about all these!" This results in confusion, lack of clarity what tools/sites are about, and also whether one remembers to recall a tool at the point of need. It was suggested that a central learning and teaching portal which pools together all such resources in one place would be welcome. These observations indicated another use for the tool: a visualisation of all teaching-related systems, their users, remit and accessibility.

5.3 Summary

This preliminary study aimed to design the prototype of an interactive network diagram to enhance the sharing of TEL practice by enabling them to identify other practitioners who use the same technology in their teaching. Participants signalled the potential usefulness of the diagram in a variety of contexts and suggested various characteristics and procedures for maximising its potential. The suggestions touched upon a number of key theoretical concepts from Community of Practice and Social Network Analysis. Participants recognised the importance of being able to identify hubs (well-connected practitioners) (Krebs and Holley 2006) and weak ties (practitioners connected to extended, cross-disciplinary networks) (Granovetter 1973) on the diagram. The potential usefulness is offset with some challenges. One participant expressed aptly, "It'd be a nice tool if it works but you don't know it [if it works or not] until you try it out."

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6. Limitations

The study has a number of limitations:

- short timescale: it was only possible to conduct the preliminary and first prototype design phases of the methodology;
- limited number of participants consulted;
- limited range of participants consulted: teaching/TEL enthusiasts and educational developers;
- lack of further professional scrutiny of design, which Plomp and Nieveen (2013) advocate if the researcher is the same person as the designer and evaluator;
- the first prototype only incorporates technologies/types: there is further scope for including pedagogic approaches (e.g. large-group teaching, group-work etc.).

Further iterations would need to extend the range of co-designers to those less enthusiastic about teaching: 'pragmatists' and 'risk-aversives' of TEL (Prescott 2013); and technical developers/visualisers.

7. Implications

This section describes the implications of this study, whose purpose was to carry out the first stage of a prototype design to enhance the sharing of TEL practice between practitioners.

7.1 Practical implications

The design principles of prototype 1 have been defined, with the potential that these can be generalisable in the design of similar tools (Plomp & Nieveen 2013). The utility of the diagram (van den Akker et al 2006; Wenger-Trayner 2015) needs further investigation through continuing with iterations of the design-based research process and extending the range of co-designers consulted. Findings also pointed to the importance of other factors, such as the location, findability and memorability of the diagram by practitioners. These are less to do with the internal design principles of the prototype and more with contextual factors to do with accessibility and awareness of the diagram. Further uses of the tool were also identified. Creating a visualisation of teaching-related university software applications that explain the purpose of each system and all the acronyms used could mitigate the confusion experienced by practitioners at the researcher's institution.

7.2 Theoretical implications

The advantage of design-based research methodology is that it contributes to theory development (van Den Akker 1999). Through this preliminary study, further insights have been gained about how practitioners share TEL practice and what their need is in terms of informal learning. It seems to be the case that moments of need arise when practitioners have an immediate issue or in the process of trying out a particular learning technology. If at this point their near peers, their disciplinary community, are not able to help, they seek support from further afield in their extended networks.

Design principles for a system that helps practitioners locate potential relevant contacts were elicited. The suggested principles confirmed the appropriateness of the combined theoretical framework and the strength of triangulation of theory (Plomp & Nieveen 2013). The visualisation is based on aspects from the theory of community of practice (domains of interest and different levels of use) (Wenger 1999) which are co-presented with aspects of social network theory (nodes, links, hubs and weak ties) (Borgatti et al n.d.). Visualisations just relying on either the theory of community, or social networks would not present users with the sufficient information to make valuable connections. It is this through combination that value for informal professional learning can emerge (Wenger, Trayner and de Laat 2011).
Scalability? What are its complications for using SNA (if at all)? Only using from this concept s such as weak ties, connections, links (what's technically possible will determine to what extent SNA is used or not!)

This study has demonstrated the strength of combining two theoretical approaches in exploring the informal sharing of practice in organisations. The added value of the visualisation is that it offers flexibility to represent domains, people, networks or groups. On their own, 'just' Social Network Analysis or communities of practice is not sufficient for such exploration. Further stages of the research could explore the potential of sociomapping (Hoschl n.d.) and scalability of the tool to represent a number of networks. Incorporating sociomapping to visualise disciplinary or organisational distance could be helpful for practitioners' decision-making. It would also be the case that in an attempt to design, develop and populate the proposed system, much would be learnt

about how practitioners share TEL practice within the university. Similarly to Hoban's change mirror methodology (2006 quoted in de Laat and Schreurs 2013), such visual mapping could also be used as a reflective tool for the organisation to reveal the power of informal networks within it.

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