

By design: Facing the academic challenges of implementing technology enhanced learning in higher education and the example of a third year biology unit

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This paper takes a design research approach to the challenge of transforming learning and teaching in higher education (HE) as it is experienced at the level of an interdisciplinary team composed of content matter experts and specialists in education. It is based on the reflections of members of the team working collaboratively to transform an undergraduate biology unit, delivered in intensive mode in parallel with a standard teaching semester to improve both student engagement and teaching staff satisfaction. The unit learning design tests 21st century active learning pedagogies in the context preparing students for their professional lives.

Using semi-structured interviews and reflective inquiry the authors attempt to uncover the salient features of the process of implementing technology enhanced learning, and generate constructive design solutions. The work is situated in the scholarship of learning and teaching as it encourages "reflection-in-action" and a commitment to sharing what works in STEM teaching and learning in contemporary environments. The teaching team focus on the complex problems of preparation, attendance, and engagement in a series of intensive labs, whilst the professional staff focus on the complex problems of innovation and student engagement in higher education.

A number of known and hypothetical learning design principles are integrated with the affordances of the chosen learning environment (OneNote) and used to propose plausible solutions. These solutions are used to iteratively refine the learning environment and reveal new design principles. The data shows improved staff engagement with the unit and the students through an enhanced role in the application and development of modern pedagogies. The paper emphasises the benefits of providing for and supporting the emergence of *microcultures*, and suggest strategies for those that wish to emulate the approach taken.

Introduction

This research reports on an innovative design and delivery of a third-year animal biology unit offered for the first time as a response to a need of improving student engagement and reverse declining attendance at lectures, tutorials and laboratory practicals.

Student (dis-)engagement is a well observed and researched phenomenon (Kahn, 2014; Kahu, 2013), that can have strong impact on the teaching team. However, the nature of the impact should not be defined too hastily. It certainly can cause academic frustration and staff demotivation, but on a positive side, it can also

provide impetus for innovative solutions. Nowadays, this means implementing digital technologies, looking more closely at task design to make skillful use of the technological tools and adopting a more holistic approach to development of student learning experiences.

One of the important questions within the discipline of learning design relates to the role teachers and learning designers/developers play in the process of designing and developing technology-enhanced learning experiences (Kali, McKenney, & Sagy, 2015; Kirschner, 2015). An opportunity to explore this question more closely was seized by a group of academics and learning development team members tasked with addressing the issue of low



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student satisfaction rates and steady disengagement in a third-year animal biology unit offered at a large, metropolitan university.

In praxis (Freire, 2000), a workgroup, or *microculture* (Roxå & Mårtensson, 2015) an interdisciplinary team of specialists representing their relevant disciplines (i.e. biology and education/ learning design) emerged, located within what Trowler (2008) refers to as a meso-level of higher education (i.e. unit/subject/discipline level) and as such are not necessarily represented on organizational hierarchies (Heinrich, 2017). The unit teaching team was encouraged to look for sensitive interdisciplinary solutions that would encourage student engagement, increase the use of digital technologies in the unit, improve student satisfaction and positively influence teaching team motivation.

The current research reflected on the enablers, roadblocks and challenges encountered by the members of this *microculture* while designing and developing an innovative delivery of the above-mentioned unit. To this end, the authors identified two objectives of the research.

First, the authors investigated how the opportunities for learning offered by the freshly introduced OneNote Class Notebook were perceived and enacted by the teaching team. These opportunities took form of educational, technological and social affordances, made salient to the teaching team by the authors whose intention was to create a “world of learning” (Kirschner, Strijbos, & Kreijns, 2004). The leading idea behind the concept is to encourage learners’ agency by offering them an educational environment filled with multiple and diverse opportunities for learning within which learners are responsible for their learning by acting, making choices, and taking opportunities.

Second, the authors looked deeper into the collaboration between the members of the *microculture*. This consisted on reflecting on the ways the collaboration took place and describing a model emerging from the analysis. The model combined an institutional support facilitated through formal meetings with more informal, organically evolved form of collaboration based on a subtle net of connections operationalized through informal catch-ups between the members of the two teams.

The development of the model prompted investigation of the effectiveness of such model, especially from the perspective of raising awareness of the potential offered by close collaboration within a *microculture* of an interdisciplinary team. In effect, such a collaboration can serve the higher purpose of enhancing scholarship of learning and teaching and ensuring a focus on the quality of teaching practice (Mårtensson, Roxå, & Olsson, 2011; Trigwell & Shale, 2004).

Bain and McNaught (2006) argue that teachers’ beliefs impact on the use of technology in their practice. However, teachers’ beliefs are not necessarily fixed constructs, and may change over the years (Goodyear, Markauskaite, & Kali, 2010). The authors are mindful of the difficulties associated with changing academic teaching practices. Mårtensson, Roxå and Olsson (2011) make the point that “despite attempts made by both internal stakeholders ... and external stakeholders ... to influence practices in higher education, teaching mostly remains unaffected”. Seven years later the difficulties remain.

To investigate closer the potential for enhancing scholarship of learning and teaching offered by *microculture* of a small, interdisciplinary team, the authors of the current research made an effort to apply the following principles of the scholarship of learning and teaching, as outlined by Mårtensson, Roxå and Olsson (2011):

- Teachers must own sustainable change.
- Informed discussion and documentation is paramount for achieving a quality culture in relation to teaching and learning.
- The driving force for change is peer review among teachers.
- Clarity in vision and careful timing while taking structural measures is a crucial part of leadership.

The authors were interested in finding out to what extent the collaboration within the emergent *microculture* influenced academics’ beliefs, their pedagogic content knowledge and teaching practices. A hypothesis has been put forward that through the collaboration within the *microculture*, the members of the workgroup raised their awareness of the learning and teaching potential offered by the proposed innovations and broadened their perspectives on learning and teaching.

To explore the above-outlined objectives, the following research questions were formulated:

1. What was the overall experience for academics implementing OneNote in the unit?
2. Did academic collaboration within the *microculture* impact on the scholarship of learning and teaching. If so, how?

Context of the study

The unit under investigation is a third-year Animal Biology taken by 92 students coming from diverse disciplines, predominantly Science (n=67), but also Education (n=9), Health (n=5) and a mix of double degrees with Business (n=11). The unit was offered for the first time in semester 1 2015, using traditional delivery modes such as lectorial and laboratory practicals, spread over 13 weeklong semester. The approaches to learning and teaching

privileged inquiry-based learning with hands-on activities during laboratory practicals and interactive lectorials. At the end of the semester, a field trip was planned, however due to low student engagement it was cancelled. The disappointment of cancelling the field trip, combined with decreasing attendance not only at lectorials but also at the laboratory practicals that required the purchase of expensive laboratory materials caused a lot of staff concern. This resulted in a tendency of staff to over-assess, in an effort to force attendance and participation. Student evaluation surveys conducted in mid-semester and at the end of the semester were 2.8 out of 5.0, which also indicated low student satisfaction with the proposed format. In conclusion, the unit was ripe for redevelopment and a fresh approach.

The redesign team decided to approach the problem holistically, going beyond the constraints of traditional unit delivery normally limited by timetabling 13-week long semesters, and the associated procedures and processes operating on a pre-determined schedule. The new teaching model, trialled in semester 1, 2016, was based loosely on an Intensive Mode of Delivery (IMD) model, widely used in distance education, with modularisation and a significant online component as a structural frame supporting the learning design.

There is no one, overarching definition of the IMD. It could be described as an umbrella term containing a broad variety of models, all characterised by intensive delivery over a shortened period in relation to the traditional semester (Harvey, Power, & Wilson, 2016; Hesterman, 2015; Male et al., 2016). The proposed model was composed of four modules, supported by fewer, but more intensive face-to-face sessions, all directly connected to the assessment.

This frame served multiple objectives defined by the workgroup, or a *microculture*. These included testing IMD as a way of increasing student engagement, improving student satisfaction and progression rates, and emphasising more blended learning.

The unit content was organised in four thematic modules, with each module comprising a self-managed online learning component, followed by one intensive day of face-to-face delivery involving lectorials, workshops and laboratory practicals. The intensive day finished with an assessment task.

All online resources and activities were provided using the OneNote Class Notebook, which was made accessible through the university Learning Management System (LMS), according to the university standard operating procedures.

Microculture

The authors will use the term *microculture* to describe an environment encompassing all specialists involved in design, development, delivery and evaluation of the unit. Heinrich (2017) observes that "microcultures are not necessarily aligned to organizational structures. Looking at groups instead of individuals or whole organizations situates the work on microcultures at the meso level" (2017, p.704). Thus, the unit is at the meso-level of analysis (as opposed to macro levels such as course or program, or micro levels such as the individual or interpersonal).

Looking at this meso-level of analysis, a team led by a Unit Coordinator and composed of academics teaching the modules, learning and teaching development team members and technical staff was established. The total number of the involved specialists fluctuated between 9 and 12. From the beginning, the challenge of managing such a diverse group became evident. The difficulty resided not only with logistics (e.g. handling conflicting priorities and busy schedules), but also with the diverse nature of the team of specialists representing different pedagogical perspectives. Formal, meeting-driven approach was not effective for managing the complexity of problems to solve, issues to investigate and questions to answer within a tight timeline. Thus, there was a need for a more sensitive, network-like approach characterised by frequent and informal interactions. Such a structure fluctuated between organic development and conscious creation by the team members. After the initial discussion of the principles underpinning the design facilitated through formal meeting, the rest of the collaboration was based on intensive, frequent and informal catch-ups inside particular sub-teams.

That is, four sub-teams were formed, according to modules to be developed and delivered. Each sub-team was composed of teaching academics, supported by their tutors and technical staff, one learning designer and one research/ evaluation specialist. The authors note here that the informal nature of activities does not imply an absence of planning (Eraut, 2004; Rienties & Hosein, 2015), quite the opposite. The frequent and meaningful discussions allowed flexibility in planning and in reacting to encountered problems. Roxå & Mårtensson (2015, p. 195) contend "academics have more frequent, sincere, and emotionally dense personal conversations with a small number of trusted and significant colleagues". Such *significant conversations*, build on mutual trust and professional respect enable formation of *strong ties* inside the *microculture*.

Literature also stipulates that for learning developers/ designers the ability of creating *strong ties* with academics and supporting staff has far-reaching consequences (Roxå & Mårtensson, 2015; Roxå, Mårtensson, & Alveteg, 2011). The authors made an

important effort to interweave strong ties with all members of the sub-teams, which required creating an environment underpinned by three heuristics: *trust*, *shared responsibility* and *developmental agenda* (Roxå & Mårtensson, 2015, p. 198) within which *significant conversations* took place. In this case, the content of significant conversations shifted from changing logistical details related to unit delivery to creating the learning environment, and creating a compelling experience for the students.

The *significant conversations*, carried over the duration of the delivery enabled deep reflection within both, the individual sub-teams and the *microculture*, and facilitated targeted adjustments to be made after each module. These reflections were prompted by a careful evaluation strategy that sought student opinion at the end of each module through short questionnaires administered at the end of each intensive teaching day. Collected data were analysed immediately and findings were used as a platform for new (and more) *significant conversations*. There was a commitment from the teaching team to act on student evaluations in each of the four modules of the unit.

Research methodology

The data collection included post intensive questionnaires of the students, in-depth interviews with the teaching team by the evaluation specialist, and a debriefing activity organised by the Unit Coordinator conducted at the end of the experiment. Student satisfaction surveys that form part of the centrally delivered unit evaluation process complemented the data collection strategy. For the purposes of the current research, only data collected through in-depth interviews and the debriefing activity with the teaching team is used. Their comments can be found in indented quotes below in findings and discussion.

The qualitative data were analysed in two stages. First, the qualitative data were color-coded to identify emerging patterns which were next classified in categories using the theoretical framework of discursive psychology (Jørgensen & Phillips, 2002). Discursive psychology argues that categories are mental representations that allow an individual to create a meaning and the language used by people to describe the environment reveals the ways they perceive it. Once the categories were identified, the interpretation of the data was conducted from two perspectives: the academics' viewpoints and experiences in implementing OneNote Class Notebook (research question 1), and the effectiveness of the emergent *microculture* in promoting the scholarship of learning and teaching (research question 2). Finally, the categories were analysed according to the following the six characteristics of design

research, as defined by Reeves, Herrington & Oliver (2005)

- “ A focus on broad-based, complex problems critical to higher education,
- The integration of known and hypothetical design principles with technological affordances to render plausible solutions to these complex problems,
- Rigorous and reflective inquiry to test and refine innovative learning environments as well as to reveal new design principles,
- Long-term engagement involving continual refinement of protocols and questions,
- Intensive collaboration among researchers and practitioners, and
- A commitment to theory construction and explanation while solving real-world problems.”

Findings and discussion

A focus on complex problems

The analysis revealed that the teaching team strongly supported the decision to shift IMD and to focus on experiential, authentic, situated learning in the lab. Although the teaching team was initially focused on student engagement, the opportunity to create a more personalised learning experience was perceived and welcomed by all within the *microculture*. One member of the teaching team noted:

“OneNote is really like a personalised notebook for the students. It allows us to produce content and place it in front of them, but it allows them some flexibility for how they use that material. So they can have online notebooks, they can have online reflections where they can record that material. If there is a particular part of the content that they don't understand then they can take that out and highlight it to us, particularly through the use of collaboration space as well. So it's a method for us to deliver but it also gives them some flexibility to consume that information in a much better way.”

This observation reveals deep thinking about both the teaching practice, the learning environment and a growing awareness of the scholarship of learning and teaching, which ultimately increases the quality of learning experience for students.

The technology enhanced learning approach was facilitated by the use of OneNote Class Notebook, which constituted a departure from the standard university LMS. Students were directed through the university LMS and via email to access the Class Notebook. Due to the university regulations, the university LMS continued to

play a central role in enrolment, assessment and feedback. OneNote would be the main delivery mechanism for the unit content, and the central communication and collaboration tool.

There was an imperative to shift the focus from mere content consumption to a more active delivery, such that students could tailor to their own needs as learners. With the content delivery conducted entirely through OneNote it was envisaged that students would have access to their own notes whenever the need arose to study. Other benefits included the ability to work through the material and reshape it according to their interests and abilities. The *microculture* purposefully took advantage of these affordances in designing the content and the flexible learning activities that came with it. These opportunities were also perceived by the teaching team who made an effort to explore them more deeply.

Integration of design principles with affordances

The following five broad opportunities for learning offered by OneNote Class Notebook were identified:

1. Distribution: content delivered directly into the student's personal notebooks.
2. Flexibility of an ongoing availability: content available at any time on multiple devices.
3. Contextualisation: the design of interaction guides and summaries to assist students in developing their own note taking skills in the context of preparing for the intensive days. This included hyperlinks to relevant content, guiding questions, tagged activities defining by mode of interaction.
4. Real-time collaboration: the ability to share and comment on each other's work in real time, and the sense of connection with the teaching team in the weeks between face to face intensive days.
5. Orchestration: The ability of the teaching team to manage in real time multiple activities in a multi-layered and constrained system (Dillenbourg, 2013).

The learning environment was designed to take advantage of the known theories of learning to emphasise certain learning behaviours such as repetition, chunking and retelling. Accordingly, the learning designers felt that it was a good match for these activities with a wide range of affordances, to support self-directed learning. The challenges to implementation would be found mostly in bringing the teaching team along on the journey to transition from a content delivery mindset into an experiential guide mindset. One respondent noted:

"I'd never used OneNote prior to this, so it was really a baptism of fire for me."

The inherent difficulties in managing a transition like this can hardly be overstated, and they often mirror those that are felt by the student body. Wanner and Palmer (2016) analysed risks associated with flipping the classroom and found that perceptions of the time required to develop flipped approaches, along pressures to innovate often have a demotivating effect on teachers, particularly where there is a lack of institutional support. To address the learning design team staged the design and development of the learning modules in OneNote and modelled effective learning behaviors for the teaching team.

There were things that the teaching team continued to do after the implementation of OneNote that highlighted the persistence of recurrent practices (Trowler & Cooper, 2002), even when opportunities for new ways of teaching and learning were afforded. With a focus on the wholesale transformation of the unit, many of these recurrent practices are perhaps understated. The following comment supports this hypothesis:

"Well, everything has changed, so we've changed; The way we've presented the material, the timetable, the way we interact with students. We've gone online, as well as doing intensive face to face practicals. There's pretty much nothing that we haven't changed this semester, apart from the basic learning outcomes that we are trying to achieve."

The teaching team took care to prepare students for the intensive days with the necessary content knowledge and to spark enquiry through the technological affordances of OneNote. The data analysis suggests that despite the new possibilities for interaction between students, the content and the teaching team, the One Note was still perceived as a delivery platform, as evidenced by the following comment:

"The first version of the unit last year didn't have any online component at all, and this unit, basically we've put all of the content online. It is a mixed mode so we have online eLearning that goes for two or three weeks leading up to an intensive face-to-face residential school type day. So the students use OneNote as the main platform. They look at videos, they look at lecture notes, they look at readings we've put up there and do activities that we've put up there for them."

As opposed to the online component, the opportunities for learning and student engagement offered by the face-to-face, intensive day were immediately perceived and taken up by the teaching team. OneNote provided the opportunity for greater engagement for students even

with the reduction in frequency of contact with the teaching team with the shift to four intensive days from the standard 13-week pattern. The reduction of frequency resulted in dynamic and engaging experiences during the intensives as evidenced by this comment from a teaching team member:

"The intensive day was fantastic; it is a long day, for the teaching team and for the students. The structure for the second intensive days was that the students would show up at 9 o'clock in the morning and a 2-hour lecture/lectorial took place then. So that was really an interactive session at the start of the day just to sense where they were at with the material and ensure that they were understanding what was going on. ... They were amazing. The whole day they kept going. It's a long day and they kept the enthusiasm up and they made it through, and I think they actually enjoyed the experience. "

It seems that technological affordances for learning require more effort to be realised and enacted. This responsibility would normally fall to learning designers in this particular context, although it could be argued that teaching teams would benefit from encouragement to take on this task within the context of similar *microcultures* elsewhere. Direct involvement of academics in the design of the learning environment and the creation of content allowed the learning designers and developers the opportunity to expose the teaching team to new ways of interacting with student via OneNote.

Inquiry to refine the learning environment and reveal new design principles

The interview responses uncover how the teaching team refined the approach and the online environment, seeking feedback from students and undertaking reflective observations after each of the four intensives.

"There is a general lack of experience with online teaching environments (within the teaching team). We are shifting towards blended learning, and not many teachers understand the composition, how much, how often, how to design and execute activities. What does a good online environment look like?"

It is this uncertainty that may contribute to demotivation of academics asked to flip the classroom without any real guidance on what or how that may work (Wanner & Palmer, 2016). The *microculture* worked to counter these apprehensions, to ensure that the technological hurdles for adoption were minimal, and there were clear suggestions for action built into the initial delivery.

Content was prepared directly in OneNote, using a development area that only the teaching team had access to. The *microculture* was encouraged to be familiar with the editing conventions within OneNote. The continued success of delivering the unit in this way is reliant on staff becoming more confident in working directly within OneNote, just as their students do. Modelling of this process of working in OneNote was seen as an essential design principle.

The *microculture* saw the opportunity to separate the design phases into four iterations coinciding with the four modules, and learned from each iteration how best to respond to the demands of the students. In the first module, it became apparent that the teaching team was not explicit enough with the ways in which they wanted students to interact with the material, so an interaction guide was created with explicit instructions on how to interact with the content. This design principle of contextualization and orchestration only became apparent through the reflections of the teaching team and their work within the *microculture*.

The *microculture* monitored page edit activity as the first module went live and saw a variety of ways in which the instructions were being interpreted. Being able to view page edit history and individual student activity was use one method of gauging the response of students to tasks within each module. In some instances, students responded in ways that were unexpected, such as using the collaboration space within the Class Notebook to produce how-to guides for their peers on aspects of the unit and the technology. Supporting and encouraging a diversity of collaborative responses to the learning activities was seen by the *microculture* as a design principle.

Long-term engagement and refinement of research method

The unit is available once a year, and each year the teaching team reconvenes to learn from previous offering, and improve the unit based on student and teacher feedback. The initial effort to set up the unit anew each year would be unsustainable, without the long-term engagement of the learning and teaching development team. Through a repeated critical reflection upon the development and implementation, there exists the possibility for the continual refinement of the research method.

The multiple cycles of iteration within the semester, and over the year enables teaching staff to learn from their engagement in the process. Gradually the learning design team intends to scale back their involvement in the unit to allow the academics time to carry on with the work. It is hoped that growth in the capabilities of the teaching team will allow them to maintain and extend upon the

initial delivery. Key to this approach is building in opportunities for feedback and reflection:

"One of the key aspects of the first delivery of this new method or learning situation is that we've been constantly seeking the feedback of students. After each online module or each intensive day is delivered we've gone to students and asked them what they think. And we actually change between each intensive day how we've been delivering based on the feedback the students have given us. And we've seen, how the students are working with us, how they're enjoying the material, and improve steadily through the unit as it is delivered because of that feedback."

Student surveys at the end of each intensive allowed the *microculture* carefully negotiate the refinements in the unit delivery at each iteration. Student feedback was guiding the *microculture* in making changes to the unit as it progressed, and informing the development process for future iterations. The teaching team were allowing the students to guide the evolution of the unit for themselves and future cohorts.

"Make sure that you are always assessing for knowledge gaps, because there will be students that don't get what is going on and don't feel confident in speaking up in the collaboration spaces as they are at the moment, or may not have the peer groups that are able to support them through that."

Intensive collaboration

The *microculture* consisted of various mid-career academics working in collaboration with the learning designer, instructional multimedia developer and the evaluation specialist. The future success of this unit is dependent upon staff having the trust, professional confidence and the technical ability to create and deliver their own learning experiences through this particular mechanism.

"We couldn't do this on our own because we are not learning designers, we are not experts in these areas, and so we have worked with (the learning design team)... and they bring the expertise in the delivery of the material, the expertise in OneNote, the expertise in terms of the pedagogy of how we deliver it as well."

The learning design team were interested in supporting the change processes involved in making this project a success, given the inherent challenges. This particular experiment had begun even before the software platform had been distributed widely across campus. There was a lack of technical know-how, and certainly no guidance on

how best to implement as a teaching tool. Even now, the resources that were developed during the experiment are not widely disseminated, and largely inaccessible to the academic staff. Henderson, Beach, & Finkelstein (2011) in their analysis of change strategies in undergraduate STEM practice found that "Effective change strategies: are aligned with or seek to change the beliefs of the individuals involved; involve long-term interventions, lasting at least one semester; require understanding a college or university as a complex system and designing a strategy that is compatible with this system."

Theory construction and real-world problem solution

In addressing the complex problems of attendance, preparation and engagement, the observations of the teaching team are indicative of the benefits of the approach. With respect to attendance;

"We are no longer standing in front of empty classrooms, as we are now averaging 99% student attendance on the face-to-face intensive days."

Blending online and face-to-face learning experiences seems to have had an effect on encouraging deeper learning through better preparation for the intensives according to one teaching team member:

"I've never encountered a group of students in 30 years of teaching that were so on top of the subject material. Their ability to answer questions and ask questions was phenomenal compared to the sort of response you get when you ask questions at the end of a 2 hour lecture."

Another positive change noted by the teaching team was increase in student engagement.

"The students are so much more engaged, and are understanding the unit material better now. They appear more independent, involved and have taken ownership of their own learning. They were enthusiastic and appeared to enjoy the experience."

In designing the unit, the teaching team was taking a calculated risk. They accepted the challenge of finding time to get up to speed on a new software platform, and develop content for the new learning environment. The main challenge was time in preparation and formatting of the online resources, but once they were created, they could be kept and modified for future iterations of the unit. Facing some of these challenges as a team can actually be seen as a positive for the team learning.

"So I guess my advice is give it a go, don't underestimate how long it will take to prepare the materials"

"I'd say get a good head start if you're going to go down this path. We decided to do it late last year and really only had a few weeks to get on top of using OneNote and so on."

"Developing flipped content is never easy, and doing the first was difficult, we were using new tools (OneNote) and so we were all at risk of underestimating how much time it was going to take."

Making a change like this is a big task, and getting help from experts in learning design, ensuring the whole teaching team is involved and 'on board' is essential to its success.

"You can't do it on your own, you actually have to get experts to come in and help you, we had the use and the collaboration of three experts in the area and that made this possible. It wouldn't be what it is without them."

"We've turned the whole unit upside down in one go, if things had been different I would have chosen maybe to deliver part of the unit this way and part of it the more traditional way just to ease into it and get the students used to it."

Based on the experience of conducting this experiment we hypothesise that the modern higher education environment would benefit from the creation of models and frameworks that acknowledge the autonomy of *microcultures* that exist outside of the normal structures of the organisation. Such models would involve a reconceptualization of academic work as practice (Boud & Brew, 2013), and an emphasis on supporting the social networks that spring up around it. These models would also involve such *microcultures* taking strong ownership, having decisive power, creating strong ties internally and with strategic alliances, and focus on independent work done in partnership.

According to social network theory, key nodes in the network would be academics, smaller nodes would be peripheral actors, and the density of the network and the frequency of interactions would be defined by each particular node. In this particular model there is no need for boundaries, and in a very natural way taking ownership of one's own work requires drawing on the collaborative support of others when the need is there. Consequently, the problem of overstepping boundaries is negated by the creation of the network.

Summary of findings and some suggestions

For those wishing to emulate this approach it is important to emphasise that *microcultures* are an emergent property of the social climate that gives rise to them. It is therefore more productive to promote and support the conditions necessary for their emergence than to attempt to 'recreate' them. Recognition of the individual strengths of the members of any team is always a good place to start. Then the identification of a significant issue or problem to solve provides an important catalyst around which the team can form. It is beyond the scope of this paper to suggest ways to avoid the formal boundaries that often take shape within organisations around a particular project, suffice to say that organisations need to become more aware of the ways in which their hierarchies are often circumvented. This is not to discourage creative circumvention, but to the contrary, support a culture in which people involved in academic practice are encouraged to take risks.

In this case, the problem was flagging attendance and disengagement. The motivation to change came from within the team, and there was a commitment from all involved to make significant to change, not only to the unit, but also to the way in which the process of unit redevelopment was undertaken. Shared inquiry into improving the delivery of the unit, and how the students received this directly fed into the improvements made from module to module.

Conclusion

This paper reported on an experiment conducted as a response to declining attendance, preparation and engagement in a third-year science unit. The data analysis focused on two broad questions, first what were the experiences of the members of the *microculture* with the new technologies and second, to what extent did they enhance the scholarship of learning and teaching. The data revealed an underexplored and yet potentially rich area for developing a shared understanding of the potential for *microcultures* to emerge as the locus for professional development, transformational change and the enhancement of teaching and learning in higher education.

The reported experiences of the academic and professional staff involved indicate an environment of mutual trust and respect, which resulted in the opportunity to conduct significant conversations that benefit the learning environment. The nature of this project was dependent on the ability of people to see their part and play it well. The three conditions: *trust*, *shared responsibility* and *developmental agenda* (Roxå & Mårtensson, 2015, p. 198) was the climate within which *significant conversations* took place. The effect of

focussing the attention of the *microculture* on solving complex problems, such as attendance and engagement that lead to reflective dialogue that elevated the scholarship of teaching and learning.

Many questions remain however, such as whether the change in practices survive the disbanding of teaching teams, or changes to the unit. Is it possible to provide the necessary conditions for *microcultures* to emerge or is this simply a "luxury" model, difficult and expensive to replicate? The authors consider that this research has the potential to produce readily applicable design knowledge (Reeves, Herrington, & Oliver, 2005).

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