

INVESTIGATING THE LONGITUDINAL IMPACT OF PARTICIPATING IN SCHOOL-BASED LESSON STUDY ON MATHEMATICS TEACHERS' PROFESSIONAL COMMUNITY

Emily Lewanowski-Breen¹, Aoibhinn Ní Shúilleabháin¹, & Maria Meehan¹

¹School of Mathematics and Statistics, University College Dublin

Teacher professional communities have recently figured among the most influential factors for supporting teachers in their learning and in enacting educational change in schools. While lesson study has been documented as a means to support the development of such communities, previous studies have not addressed the sustainability of the professional communities which emerge. In this study, we follow-up with six mathematics teachers from two post-primary schools in the Republic of Ireland, who engaged in school-based lesson study in 2012/13, in order to investigate the long-term impact on their teacher professional community. Our findings indicate that the mathematics teachers in both schools had developed a predominantly mature professional community during their participation in lesson study in 2012/13. Moreover, we find that six years on, the community has been sustained in one school and further strengthened in the other. These findings suggest that lesson study may be a viable model to develop and sustain mathematics teachers' professional communities in the long-term.

INTRODUCTION

Growing trends have emerged in recent years which position professional communities at the forefront of attempts to support teachers in becoming life-long learners and in enacting educational change in schools (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006; Vescio, Ross, & Adams, 2008). As outlined by Vescio and colleagues (2008), such communities are rooted in the premise of improving both teacher practice and student learning and can thus provide a means to connect teacher learning to the lived realities in the classroom (Sargent & Hannum, 2009). This is framed against a national backdrop of increasing emphasis on teacher learning and collaborative practice (Teaching Council, 2016).

Within this arena, lesson study (LS) has emerged as a valuable means to cultivate teacher professional community development (Baricaua Gutierrez, 2016; Lewis, Perry, & Hurd, 2009; Lieberman, 2009) as it provides a context in which teachers can collaborate with one another and is rooted in both teacher learning and student learning (Lewis et al., 2009). However, previous studies have not examined the long-term impact of LS on teacher professional communities. Specifically, research is needed to provide insight into whether the emerging communities are sustained in the years following participation in LS. This research attempts to address this gap in the literature by conducting a longitudinal study with six mathematics teachers, from two post-primary schools in the Republic of Ireland (ROI), who engaged in school-based LS as part of a comparative case study in 2012/13 (see Ní

Shúilleabháin, 2016). This study will specifically address the following research question: How do post-primary mathematics teachers perceive the long-term impact of participating in school-based LS on their teacher professional community?

LITERATURE REVIEW

Teacher professional community

Within the last decade, a growing body of research has emerged which documents the development of professional communities and their impact on teaching and learning practices (see Vescio et al., 2008 for review). As argued by Fullan and Hargreaves (1992), teachers must be encouraged to engage with their colleagues in the context of a learning community in order to cultivate more progressive practices within the profession. This view is supported by empirical research which has shown that professional communities provide teachers with a fertile ground for new learning, whilst also having a positive impact on students' learning (Grossman, Wineburg, & Woolworth, 2001; Vescio et al., 2008). Such communities can thus serve as a valuable context for school-based professional development (PD), instructional improvement, and school reform (Stoll et al., 2006).

Teacher community development

While the concept of teacher community has been extensively referenced in recent years, the defining characteristics of such communities are not simply delineated as evidenced by the multitude of interpretations offered by scholars in the field. A 'professional learning community', for example, is regarded as a cohesive group of teachers who work together in an effort to collectively enhance both teacher and student learning (Vescio et al., 2008); also commonly referred to as a 'teacher professional community' (Grossman et al., 2001). A 'community of practice', on the other hand, is broader in its conception and can involve members from a diverse range of professional backgrounds (Wenger, 1998). Despite the variations in conception, however, common characteristics have emerged within the research literature. As posited by Westheimer (1999), teacher-based communities are anchored in shared values and understandings, mutual engagement, interdependence, meaningful relationships, and a concern for minority and individual views. Vescio et al. (2008) similarly contend that teacher communities must be rooted in the premise of improving both teacher practice and student learning. These attributes are reflected in an empirical framework developed by Grossman et al. (2001, p. 94) for teacher community formation.

Lesson study and teacher professional community

While different models and approaches to support community development have been documented in the research literature (see Grossman et al., 2001 for example), numerous international studies have pointed to the value of LS in cultivating teacher professional communities (Baricaua Gutierrez, 2016; Lewis et al., 2009; Lieberman, 2009). As documented by Lewis et al. (2009), LS not only supports teachers in developing a shared goal as part of the research lesson, but it also increases the

visibility of their pedagogical ideas and beliefs; an important aspect of professional community formation. Moreover, a study conducted by Baricaua Gutierrez (2016) emphasised the value of the reflective process in encouraging teachers to collectively analyse emerging instructional practices, thus supporting them in forming a genuine community, whereby all contributions are valued. This can subsequently encourage teachers to become more open to sharing their ideas and opinions with each other within the context of a professional community.

METHODOLOGY

Participants

In order to investigate the long-term impact of participating in LS on mathematics teachers' professional community, a longitudinal study was conducted with mathematics teachers from two post-primary schools in the ROI. Both schools, Doone and Crannóg (pseudonyms), had previously engaged in school-based LS as part of a study in 2012/13 (see Ní Shúilleabháin, 2016). While both schools are urban-based, they differ in their student cohorts. Doone, for example, is a single-sex boys' school comprising 550 students, whereas Crannóg has a mixed gender population of around 900 students. Although some members of the LS groups have left their respective schools since the initial study, three teachers from each school, who took part in the LS cycles, volunteered to participate in this follow-up research. These participating teachers varied in their years of experience teaching mathematics (see Table 1), with one teacher, Nora, working as a volunteer resource teacher in Doone.

Table 1: Participating teachers' current years of experience teaching mathematics

(N=6) Crannóg Doone

Name Years of experience Name Years of experience Eileen 9 Kate 9
Fiona 37 Lisa 13

Walter	18	Nora	41
--------	----	------	----

Data collection and qualitative analysis

Data for this study were generated through one-to-one semi-structured interviews with the six participating teachers, which varied in length from 20 to 35 minutes. The questions were informed by the dimensions outlined in Grossman et al.'s (2001, p. 94) framework for teacher community formation: (D1) Formation of group identity and norms for interaction, (D2) Navigating group conflict, (D3) Negotiating the essential tension (D4) Communal responsibility for individual growth, which will henceforth be referred to as D1, D2, D3 and D4 respectively. These interviews explicitly addressed both the teachers' recollections of LS and their post-LS experiences in order to investigate the long-term impact on their community. Qualitative analysis of the

transcribed audio files was conducted in NVivo according to the four dimensions in Grossman et al.'s (2001) framework. Each dimension was further divided into codes which aligned with the descriptors under the respective dimension e.g. "identification with subgroups" (Grossman et al., 2001, p. 94) The individual interviews were examined for evidence of the main themes, with the responses being coded using the codes included therein. Once coded, the responses were divided into three time periods (pre LS, LS 2012/13, and post-LS). Each row of codes from the framework was then analysed and the most prevalent code was identified in each case as related to the associated stage of community development; beginning, evolving and mature. Each theme was subsequently assigned the most dominant stage of development based on the prevalence of the codes included therein (e.g. D1 = mature). This was repeated for each time period.

FINDINGS

Analysis of the interview data revealed that mathematics teachers in both schools felt their participation in LS has had a long-term positive impact on their relationship with their colleagues. Our findings also suggest that while the teachers in the two schools did not engage with one another in the context of a professional community prior to their participation in LS, both teacher communities were predominately in the mature stages of development during the LS cycles in 2012/13. Furthermore, we find that the professional community which emerged in Crannóg has been further strengthened since the teachers' participation in LS, while the professional community in Doone has been sustained in the years following the initial study. In this paper, we expand on the findings for Crannóg as the teacher professional community in this school showed evidence of strengthening in the years following LS.

Crannóg Pre-LS

Prior to their participation in LS, the mathematics teachers in Crannóg did not engage with one another in the context of a professional community. While they had timetabled department meetings, these were primarily concerned with matters relating to administration rather than teaching and learning. Moreover, the teachers only occasionally exchanged resources in an informal and would not have openly provided feedback or discussed the shared resources as their brief encounters were "not conducive to constructive criticism" (Eileen). Nevertheless, they got on well as a "group of teachers" (Grossman et al., 2001, p. 4) and reported a sense of collegiality within the mathematics department prior to LS.

Crannóg LS 2012/13

Based on the mathematics teachers' recollections of LS, there is evidence to suggest that they had developed a mature teacher professional community during the LS cycles in 2012/13. As indicated in the analysis, the most dominant stage of development for D1 and D2 was mature, while D4 was classified as evolving/mature. However, there was no evidence of D3 or its associated codes as this dimension was not discussed in the context of LS 2012/13

(see Table 2 for summary). We expand on D1 and D4 below as these dimensions were most widely discussed during the teachers' recollections of LS and also featured references to the beginning and/or evolving stages of development, although these were much fewer in number and were not evident in all three interviews.

Table 2: Summary of responses for LS showing the most dominant stage of development for each dimension, in addition to the presence of beginning, evolving and mature codes across each dimension

	present		Mature codes		Dominant stage of
Dimension	Evolving codes		present		development
Beginning codes	present				
D1 X - X Mature D2 - - X Mature D3 - - - No evidence					
D4	X		X	X	Evolving/Mature

In relation to D1, it was clear that the teachers in Crannóg identified with the group as a whole during LS as evidenced by Eileen's recollection that "[LS] made us all work together as a really good team". The teachers also continually pointed to their communal sense of responsibility for the LS work and recognised the value of having diversity in perspectives within the group, thus aligning with the features of a mature professional community. While there were codes relating to the beginning stage of development evident in D1, these were primarily attributed to the presence of informal subgroups within the larger LS group. However, the teachers acknowledged that these subgroups were not formally maintained, and they continued to identify with the group as a whole throughout the LS cycles.

With regards to D4, the teachers were keenly aware of the obligations of group membership such as contributing to the LS meetings, sharing resources and contributing pertinent information. However, Eileen admitted that she initially held back during the LS meetings due to her inexperience, which aligns with the beginning stage of development: "I probably gave the least because I had just qualified". Additionally, there were more accounts of teachers acknowledging their colleagues as a resource for learning (Evolving) rather than demonstrating an active commitment to each other's professional growth (Mature):

It was interesting just working with colleagues and hearing their different ideas, even if it's on a different methodology, just hearing their different ideas that was interesting as well. So yeah, whenever you have a discussion with somebody you always learn something (Fiona).

Crannóg Post-LS

Based on the analysis of the post-LS data, our findings suggest that the mathematics

teachers' professional community which emerged during LS 2012/13 has been further strengthened in the years following the initial study. While D2 remained mature and unchanged, both D1 and D4 showed evidence of further development, which we outline below. Although there was still evidence of codes relating to the beginning and/or evolving stages of development in D1 and D4, these were much fewer in number in comparison to the data for LS 2012/13 and were not present in all three interviews. In addition, references to D3 were also reported in the responses relating to post-LS and this dimension was classified as mature (see Table 3 for summary of results).

Table 3: Summary of responses for post-LS showing the most dominant stage of development for each dimension, in addition to the presence of beginning, evolving and mature codes across each dimension

Dimension	present Beginning codes	present Evolving codes	Mature codes present	Dominant stage of development
D1	X X X	Mature	D2 - - X	Mature
D3	- - X	Mature		
D4	-	X	X	Mature

In relation to D1, it is evident that the mathematics teachers continue to identify with the group as a whole and they report a stronger sense of unity within the department. The group are also welcoming of new members and they typically become assimilated into their culture of shared learning and collaboration: "We are good team, so I think anyone that comes in realises that and gets involved, and kind of realises what our ethos is" (Eileen).

Moreover, the teachers have developed new interactional norms since participating in LS, which is a further indication that their professional community has strengthened in recent years. For instance, the mathematics department now meets for 40 minutes every week to discuss teaching and learning approaches. The use of the Microsoft ecosystem has also facilitated the exchange of resources amongst the mathematics teachers and supported greater levels of engagement with one another. Matters relating to administration and planning are now commonly discussed online through Microsoft Teams, allowing more of the weekly meetings to be dedicated to the teaching and learning of mathematics. It is also worth noting that all other subject departments in the school have similarly begun to meet on a weekly basis to discuss teaching and learning approaches, in addition to administration:

We would have been one of the first departments to have met as a subject every week and then all the departments in the school meet as a subject every week. So, I think our participation in lesson study did sort of spawn off a number of

benefits for the whole school as well (Walter).

With regards to D4, the teachers reported that their participation in LS formalised the exchange of ideas and it has now become a norm within their community. While the teachers initially recognised their colleagues as a resource for learning, they have come to acknowledge a sense of commitment to their colleagues' learning and openly share ideas with one another: "I think in order to develop as maths teachers you have to work together and share your ideas otherwise it's just static" (Fiona). Although Eileen admitted to holding back during the LS cycles, she now recognises the obligations of community membership and ensures to seek for clarification and contribute ideas during their weekly meetings. These examples provide evidence to suggest that the mathematics teachers' professional community in Crannóg has been further strengthened in the years following their participation in LS.

DISCUSSION

The findings for this study support empirical research, which has shown that LS can serve as a valuable means to foster teacher professional community development (Baricaua Gutierrez, 2016; Lewis et al., 2009; Lieberman, 2009). As indicated in our analysis, the mathematics teachers in both schools developed a predominantly mature professional community during their participation in LS in 2012/13. Moreover, we find that the community which emerged in Crannóg has been further strengthened since the teachers' participation in LS, while the community in Doone has been maintained in the years following the initial study. These findings suggest that school-based LS may be a viable model to develop and sustain mathematics teachers' professional communities in the long-term.

Following from the research literature, our findings also substantiate the value of professional communities in fostering teacher learning (Grossman et al., 2001; Lieberman, 2009; Vescio et

al., 2008) and connecting it to the lived realities in the classroom (Sargent & Hannum, 2009). For example, the mathematics teachers in this study reported that their engagement in a professional community has exposed them to a diverse range of pedagogical ideas and methodologies and contributed to their development as mathematics teachers. They particularly value the opportunity to discuss the teaching and learning of mathematics as evidenced by the fact that the mathematics teachers in Crannóg continue to meet on a weekly basis to discuss their practice and share ideas.

However, given that the mathematics teachers in both schools continue to engage with one another in the context of a professional community, it is pertinent to consider the factors which promote and sustain teacher professional community development. Consistent with previous studies, our findings suggest that shared values (Westheimer, 1999), strong working relationships (Stoll et al., 2006) and positive attitudes towards self-development are all key enablers of professional community development. However, continued support from school management

(Stoll et al., 2006) and time provisions (Grossman et al., 2001) may account for the differences between the two teacher professional communities. As reported during the interviews, the teachers in Crannóg have been provided with on-going support from school management following the LS cycles and provisions have been put in place to ensure that they can continue to meet as a group. In contrast, the teachers in Doone have not been given time allocations since due to timetabling issues, which subsequently limits their engagement with one another during the school day. This may have hindered the further strengthening of their mature teacher professional community in the years following LS (Westheimer, 1999).

As a limitation to this research, not all mathematics teachers who participated in the LS cycles in 2012/13 volunteered to take part in this follow-up research. While the participating teachers reported that all members have positive perceptions of LS and believe it contributed to the development of their community, it is possible that those who chose not to participate in this follow-up study may have a different perspective on the LS experience. Nevertheless, the findings for this study provide ground for future research in the field. For example, research could be conducted to examine the factors that promote and sustain professional communities. Longitudinal case studies documenting the impact of such communities on student learning and achievement similarly await further research as this will help build our understanding of professional communities and their impact on teaching and learning practices.

CONCLUSION

Taken together, the findings of this research have important implications for teacher practice and educational policy in the ROI. First, this study provides empirical evidence to suggest that LS could serve as a sustainable model for school-based PD and support mathematics teachers in their professional growth. By developing and sustaining professional communities through LS, teachers could also establish a sustainable “culture of shared learning” (Teaching Council, 2018, p. 6), which embodies the values and principles unpinning the Cosán National Framework for Teacher Learning (Teaching Council, 2016). Moreover, professional communities have the potential to provide teachers with a greater sense of autonomy over their learning, especially as the community can address matters relevant to their own subject area(s) and school background. This is particularly relevant to the current educational climate

in the ROI, which seeks to continue building the teaching capacity in Science, Technology, Engineering and Maths education (STEM Education Review Group, 2016). In turn, teacher professional communities may help shift educational change in the ROI toward a more sustainable, teacher-led approach, that is grounded in the lived realities of the profession.

REFERENCES

Baricaua Gutierrez, S. (2016). Building a classroom-based professional learning community through lesson study: Insights from elementary school science

- teachers. *Professional Development in Education*, 42(5), 801–817.
- Fullan, M., & Hargreaves, A. (1992). Teacher development and educational change. In M. Fullan & A. Hargreaves (Eds.), *Teacher development and educational change* (pp. 1–9). London: RoutledgeFalmer.
- Grossman, P., Wineburg, S., & Woolworth, S. (2001). Toward a theory of teacher community. *The Teachers College Record*, 103, 942-1012.
- Lewis, C., Perry, R., & Hurd, J. (2009). Improving mathematics instruction through lesson study: A theoretical model and North American case. *Journal of Mathematics Teacher Education*, 12(4), 285-304.
- Lieberman, J. (2009). Reinventing teacher professional norms and identities: The role of lesson study and learning communities. *Professional Development in Education*, 35(1), 83- 99.
- Ní Shúilleabháin, A. (2016). Developing mathematics teachers' pedagogical content knowledge in lesson study: Case study findings. *International Journal for Lesson and Learning Studies*, 5(3), 212-226.
- Sargent, T., & Hannum, E. (2009). Doing more with less: Teacher professional learning communities in resource-constrained primary schools in rural China. *Journal of Teacher Education*, 60(3), 258-276.
- STEM Education Review Group. (2016). *STEM education in the Irish school system*. Dublin.
- Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change*, 7(4), 221-258.
- Teaching Council. (2016). *Cosán framework for teachers' learning*. Dublin.
- Teaching Council. (2018). *Teaching council strategic plan 2018-2020*. Dublin.
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, 24(1), 80-91.
- Wenger, E. (1998). *Communities of practice : Learning, meaning, and identity*. Cambridge: Cambridge University Press.
- Westheimer, J. (1999). Communities and consequences: An inquiry into ideology and practice in teachers' professional work. *Educational Administration Quarterly*, 35(1), 71-105.