Impact of Teachers' Participation in Networked Learning Community on Classroom Practices

Cynthia Seto
Academy of Singapore Teachers
<Cynthia_seto@moe.gov.sg>

Professional collaboration among teachers from different schools is generally recognised as a conduit for teachers to improve their practice. This paper presents findings from a study to investigate the impact of teachers' participation in a mathematics networked learning community (NLC) on classroom practices. Using a pretest – posttest quasi-experimental design, statistical analyses indicate that pre–post changes in learning environment and enjoyment scales were moderate to large in magnitude for all scales for the experimental group as compared with the comparison group. Generally, this study provides support that teachers' participation in NLC has positive impact on their classroom learning environment, especially in the scales on involvement and teacher support.

Introduction

Professional development is often the predominant strategy used by educational systems to enhance teachers' effectiveness in the classroom to improve learning outcomes of students (Darling-Hammond & Lieberman, 2012). In Singapore, networked learning communities (NLCs) are gaining prominence as a key teacher learning structure. Networked learning is a process where teams of teachers from different schools learn collaboratively to examine and reflect on their practice (Ministry of Education, 2017). NLCs provide teachers with opportunities to interact with fellow educators, engage in professional conversations about their practices, observe classroom lessons and receive feedback on their teaching. In learning from one another and with one another, teachers co-create and share new knowledge and practices to improve student outcomes (Stoll et al., 2006).

The underlying objective of professional development is to help teachers to become more effective in their practice in order to enhance student learning outcomes. Whereas instructional practices need to be considered in terms of their impact on student learning, professional development programs need to have an impact on teaching practices for them to make a difference to student learning. Premised on this belief, a learning environment framework was used to evaluate the impact of teachers' participation in a NLC in terms of the learning environments created by these teachers in their mathematics classrooms in their respective schools, as well as their students' attitudes towards mathematics. Hence, the main research question is to investigate if there is any improvement in the classroom learning environment and attitudes towards mathematics to assess teachers' participation in a NLC.

Theoretical Underpinning

The notion of networked learning is based on a situative perspective of learning. From a situative perspective, learning is an individual process of coming to understand how to participate in the discourse and practices of a particular community. It is also a community process of refining norms and practices through the ideas and ways of thinking that individual members bring to the discourse (Lave & Wenger, 1991). In this theoretical framework, individual and collective knowledge emerge and evolve within the dynamics

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of the spaces that people share and within which they participate. It is about forming a community of practice (Wenger, 1998) with fellow educators that is held together by their common pursuit of a shared learning experience. They develop practices (resources, frameworks and perspectives) which help to sustain their mutual engagement in the work or activity. Members in this community learn by "engaging in and contributing to the practice of their communities" (p. 7). By engaging in meaningful practices, they become involved in discussions and actions that make a difference to the communities that they value. The concept of community is fundamental in understanding how professional development can take place in a network.

For teachers to be successful in changing their practice, they need opportunities to participate "in a professional community that discusses new teacher materials and strategies and that supports the risk-taking and struggle entailed in transforming practice" (McLaughlin & Talbert, 1993, p. 15). Conversations among teachers in these communities should promote critical examination of teaching practice, enable teachers to collectively explore ways to improve their teaching, and to support one another as they work to transform their practice. As such, networks are locations in which specialized knowledge can be created and transferred within collaborative contexts (Jackson, 2004). In the field of teacher professional development, some key studies show that teacher networks add value for the implementation of innovations, teacher development, school leadership and improved teaching practices (Dresner & Worley, 2006; Katz, Earl & Jaafar, 2009).

According to Dewey (1896), human action is the transaction between a person and his/her natural and social environment, and is in flux as he/she seeks to keep a dynamic balance with the environment that is perpetually changing. He was of the view that "the domain of knowledge and the domain of human action are not separate domains, but are intimately connected: that knowledge emerges from action and feeds back into action, and that it does not have a separate existence or function" (Biesta & Burbules, 2003, p. 15). Based on this perspective that personal knowledge manifests in the way in which they "transact with and respond" (p. 11) to changes in the environment, knowledge and social practice are therefore intimately intertwined as well as mutually constitutive. Parallel to this view is Lewin's (1936) seminal work in non-educational settings, which recognised that both the environment and its interaction with characteristics of the individual are potent determinants of human behaviour.

Fraser (1998) conceptualised a learning environment as referring to the social, psychological and pedagogical contexts in which learning occurs and which affect student achievement and attitudes. The learning environment is the overall climate and structures of the classroom that influence how students respond to and remain engaged in learning tasks. It is also the context in which teaching acts are carried out (Arends, 2001). For quality learning of mathematics in classrooms, teachers need to be aware of the learners and the learning context and to deliver the mathematics curriculum through designing and implementing lessons that have meaning and relevance for their students. This requires teachers to have a repertoire of strategies and representations that engage diverse learners. As a professional, the teacher enacts pedagogical content knowledge in the context of learners' individual differences and the changing dynamics of classroom life. Amid this complexity, the teacher participates as a member of a community of practitioners who collaborate in support of student learning and who have the habit of mind to inquire continually into and improve their practice.

Learning environment instruments can be used to collect quantitative data for the evaluation of educational programs. Because every student spends about 6000 hours in the classroom during his/her primary (Primary 1 to 6) school years, students have a large stake in what happens at school and hence their perceptions of classroom experiences are of prime importance. Aldridge et al. (2012) advocate that the perspectives of students can provide a teacher with a valuable source of data for personal reflection and that seeking alternative perspectives through the eyes of teachers' own students can help teachers to view their own practice through the eyes of others. In a similar way, the perspectives of students can provide us with a lens for observing teaching practices that are taking place in the classrooms and with a valuable source of data for assessing the effectiveness of a professional development programme.

Perceptions of classroom learning environment have been consistently found to be related to learning outcomes in past research (Aldridge, Fraser & Sebela, 2004) and positive perceptions of the classroom are typically linked to higher achievement and better attitudes (Chionh & Fraser, 2009). For example, Pickett and Fraser (2009) drew on the field of learning environment to evaluate a two-year mentoring programme in science for beginning elementary school teachers in terms of participants' classroom teaching behaviour as assessed by their school students' perceptions of their classroom learning environment.

Research Methodology

My study adopts a pretest–posttest quasi-experimental design to compare the changes in classroom environment and attitudes of those classes whose teachers participated in networked learning community with those classes whose teachers were not in networked learning community. Data were collected from a sample of 375 students from 5 different schools through the Mathematics Classroom Environment and Attitude (MCEA) Questionnaire. The MCEA Questionnaire was developed from a modified version of the What Is Happening In this Class? (WIHIC) (Fraser, 1998) and it included a scale from the Test of Science Related Attitudes (TOSRA) (Fraser, 1978, 1981) to assess students' attitudes to mathematics. To collect data from students, I invited five teachers from a NLC who were, first, interested in participating in this research and, second, able to enlist another teacher from each of their respective schools who was not in the NLC and who would be part of a comparison group. Data collected from the experimental and comparison groups were used to identify differences in the perceptions of students whose teachers were in the networked learning community and those students whose teachers were not involved in such professional learning.

There was no control over the teaching methods used by teachers in their classrooms. Although there were no specific instructions that these five teachers in the experimental group must teach differently, it was hypothesised that the teaching strategies learnt and the exchange of instructional strategies, especially questioning techniques, with fellow educators in the NLC would have some impact on their classroom practice. This change in classroom practice was measured in terms of their students' perceptions of classroom learning environment and attitudes to mathematics before and after the teachers' participation in the networked learning community. The five teachers in the comparison group were left to teach as they normally would. The pretest data and posttest data were collected within a period of thirteen weeks. Over this period, the teachers in the experimental group had four sessions of networked learning.

To develop the MCEA questionnaire, three scales (Cooperation, Teacher Support and Involvement) were chosen from the What Is Happening In this Class? (WIHIC) because they best describe the expected classroom practices as a result of the professional learning of teachers in the NLC. Developed by Fraser, Fisher and McRobbie (1996), WIHIC measures a wide range of dimensions that are important in daily situations in classrooms. Another scale of Problem Solving was constructed to reflect the level of engagement in mathematics in the NLC and also in the teachers' respective classrooms. Eight items were extracted from the Test of Science-Related Attitudes (TOSRA, Fraser, 1978) to form the Enjoyment scale to measure students' attitudes towards mathematics. These five scales form the Mathematics Classroom Environment and Attitude (MCEA) Questionnaire. Descriptive information for MCEA questionnaire (namely, scale descriptions and sample items) is shown in Table 1.

Table 1
Descriptive Information for Five Scales in MCEA Questionnaire

Scale Name	Scale Description	Sample Item
Cooperation	The extent to which students cooperate rather than compete with one another on learning tasks.	Students work with me to achieve class goals in mathematics.
Teacher Support	The extent to which the teacher helps, befriends, trusts and is interested in students.	The teacher helps me when I have trouble with mathematics problem.
Involvement	The extent to which students have attentive interests, participate in discussions, do additional work and enjoy the class.	I explain my ideas for solving mathematics problems to other students.
Problem Solving	The extent to which students experienced the processes in mathematical problem solving	I know what questions to ask myself to solve a mathematics problem.
Enjoyment	The extent to which students enjoy the mathematics lessons.	Mathematics lessons are time well-spent.

Pretest and posttest data were used to ascertain the factorial validity and internal consistency of the MCEA questionnaire in assessing students' perceptions of the learning environment and attitudes to mathematics in the Singapore Primary 5 mathematics classrooms. Principal axis factor analysis with varimax rotation and Kaiser normalization was performed separately with the pretest and posttext data for the 40-item, five-scale version of the MCEA questionnaire. An item was retained if it had a factor loading of 0.35 or above with its a priori scale and below 0.35 with each of the other scales. This led to the removal of 3 items, with 37 items being retained in the same 5-factor structure.

The ability of each learning environment scale of the MCEA questionnaire to differentiate between perceptions of students in different classes was determined through a one-way ANOVA. The ANOVA analyses revealed a significant difference ($p<0.01$) between students' perceptions in different classes for each learning environment scales, with eta^2 values ranging from 0.13 to 0.18 for the pretest and from 0.12 to 0.21 for the posttest data for the different learning environment scales of MCEA. These results suggest that the learning environment scales based on the WIHIC can differentiate significantly between different classes in Singapore. Results of the factor analysis strongly supported the factor structure of the refined 37-item questionnaire and attested to the independence of factor scores on the five scales consisting of three learning environment scales based on the WIHIC, a newly-constructed learning environment scale and an attitude scale based on the TOSRA.

Findings and Discussions

A one-way multivariate analysis of variance (MANOVA) with repeated measures was used to identify whether pretest–posttest changes for those classes whose teachers participated in the networked learning community were different from changes for those classes whose teachers did not. The four learning environment scales and the student outcome scale (Enjoyment) were the dependent variables and the testing occasion (pretest and posttest) was the independent variable. Because the multivariate tests using Wilks' lambda criterion revealed statistically significant pre–post changes in the set of five learning environment and enjoyment scales as a whole, the individual univariate ANOVA was interpreted separately for each dependent variable.

Table 2
MANOVA with Repeated Measures and Effect Sizes for Pre–Post Changes Separately for Comparison and Experimental Groups for each Scale in the MCEA Questionnaire

Scale	Group	Mean		SD		Difference	
		Pre	Post	Pre	Post	*F*	Effect Size
Cooperation	Comparison	3.46	3.41	0.78	0.83	1.01	-0.06
	Experimental	3.22	3.69	0.77	0.84	2.71**	0.58
Teacher Support	Comparison	3.54	3.20	0.95	0.89	2.42**	-0.37
	Experimental	3.35	3.71	0.80	0.79	2.62**	0.45
Involvement	Comparison	3.22	2.84	0.84	0.83	2.85**	-0.45
	Experimental	2.82	3.43	0.76	0.91	3.21**	0.73
Problem Solving	Comparison	3.34	3.26	0.81	0.80	1.19	-0.09
	Experimental	3.26	3.90	0.73	0.69	3.79**	0.90
Enjoyment	Comparison	3.61	3.37	1.08	1.15	1.40*	-0.21
	Experimental	3.39	3.90	1.00	0.95	2.25**	0.52

N: Total=375 students, Experimental=188, Control=187
*p<0.05, **p<0.001

Table 2 presents the *F* value and statistical significance from ANOVA, effect size, average item mean and average item standard deviation for each learning environment and enjoyment scale separately for experimental and comparison students and separately for pretest and posttest. The average item mean (or the scale mean divided by the number of items in that scale) permits meaningful comparison of the means of different scales containing differing numbers of items. It also reports, separately for experimental and comparison groups, the statistical significance of pre–post changes for each scale based on ANOVA, as well as the magnitude of the pre–post difference for each scale expressed as an effect size in standard deviation units. To further clarify the patterns of similarities and differences between experimental and comparison students, the effect size for pre–post differences for each scale is graphed separately for experimental and comparison groups in Figure 1.

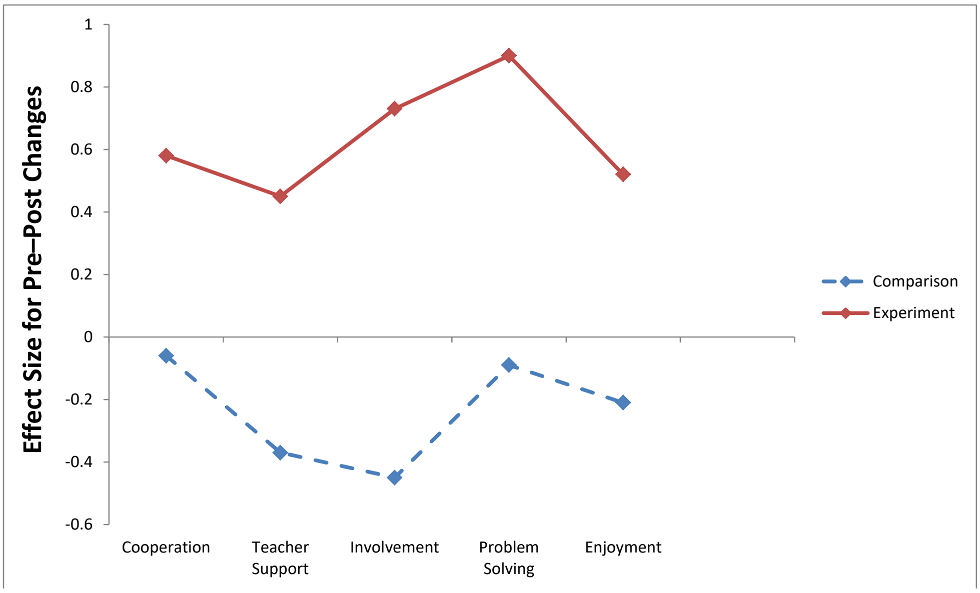

Figure 1. Effect Sizes for Pretest – Posttest Changes

For the comparison group, Table 2 and Figure 1 show that pre–post changes in learning environment and enjoyment scales:

- were statistically non-significant for two scales (namely, Cooperation and Problem Solving), but statistically significant for the other three scales (Teacher Support, Involvement and Enjoyment).
- represented a decrease between pretest and posttest for every scale.
- were small in magnitude for four scales (0.06 standard deviations for Cooperation, 0.09 standard deviations for Problem Solving, 0.37 standard deviation for Teacher Support and 0.21 standard deviations for Enjoyment) and moderate for Involvement (0.45 standard deviations).

On the other hand, for the experimental group, Table 2 and Figure 1 show that pre–post changes in learning environment and enjoyment scales:

- were statistically significant for every learning environment and enjoyment scale.
- represent an increase in scores between pretest and posttest for every scale.
- were moderate to large in magnitude for all scales (ranging from 0.45 for Teacher Support to 0.90 standard deviations for Problem Solving).

Overall the graph in Figure 1 illustrates that pre–post changes were larger in magnitude for the experimental group than for the comparison group for every MCEA scale. Also, scores for every scale increased between pretest and posttest for the experimental group, but decreased for the comparison group. This suggests that when teachers were collaboratively engaged in conversations about the use of questions to probe students' understanding and cooperative learning strategies to structure group activities in the networked learning community, they were more likely to ask questions to elicit students' ideas for classroom discussions (Involvement Scale). When teachers were more intentional in structuring group processes for pair work or small-group discussions, students were more productively engaged in learning from one another and, there was stronger teamwork.

Through discussions in networked learning community, teachers were also more prepared to provide scaffolds during small-group work and whole-class discussions. This led to students experiencing greater teacher support. When students were engaged in explaining their thought processes and building on their classmates' thinking, they were more likely to put effort into mathematics work and find learning mathematics enjoyable. These changes in teaching behaviours could lead to the positive change in learning environment experienced by the students in the experimental group. The changes perceived by students in terms of Cooperation, Teacher Support, Involvement and Problem Solving could lead to students having a more enjoyable experience in learning mathematics Therefore, the results in Table 2 and Figure 1 generally provide support for the positive impact of teachers' participation in the NLC in terms of classroom learning environment and students' enjoyment of mathematics.

Implications and Conclusion

The NLC provides opportunities for teachers to articulate what they know (and what they need to know) and helps teachers to reflect on their teaching practices with fellow educators from diverse expertise. In this collaborative learning model of professional development, teachers share their instructional strategies and learn with teachers from other schools. Hence, good practices such as use of questioning techniques and the ways to structure group work were disseminated across schools and were associated with changes in classroom learning environment and enjoyment in the mathematics classes in the experimental group.

Findings from my study suggests that teachers' participation in a mathematics networked learning community made a difference in their classroom teaching in terms of their students' perceptions of their classroom learning environment and attitudes to mathematics. It also provides empirical evidence that the practices which occurred during the NLC facilitated teachers to translate their professional learning into classroom teaching.

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