Mathematics Professional Development and Technology Integration

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**Introduction**

The issue of professional development approaches and their effect on technology integration into classroom practices has been a reoccurring theme in etec 533 discussions. A key point in assumptions made about technology use was ‘Students are the center of our classrooms and integrating technology that will lead to learning environments that promote student success is good use”. During the interview with a colleague it became clear that although this teacher was using technology in other curriculum areas and valued the use of technology to enhance student learning, “it was like night and day the work they could produce”, “……..opened my eyes to what technology can do as a teaching and learning tool in my classroom….”, she was hesitant to use it in her Mathematics teaching and learning environment. “I haven’t used technology for Math teaching, used it mainly for Language Arts and cross curricular with Science and Art.”, “..but I think it is important, I’ve gone on the National Library of Virtual Manipulatives occasionally but I can’t say I have done a lot with my students in math instruction or assessment, with technology.” This interview was the impetus in reframing this issue about PD to include integration in content areas: What elements need to be present in professional development to lead to effective technology use in mathematics learning environments?

Among the number of variables that affect technology integration, professional development has been found to be important. However, only certain approaches to professional development support technology integration by teachers. Professional development that is teacher driven, long term, accessible, incorporating support in authentic classroom situations, that is clearly linked to curriculum outcomes and gains in student learning appear to be the most effective. This paper critically examines recent research literature related to professional development and technology integration in mathematics teaching and learning environments.

The set of articles critically analysed in this paper deal with professional development that leads to technology integration in various content areas and focuses in the area of mathematics. To ensure relevance to my own context, it was important to include Canadian research along with international research. The review of alternate forms of professional development due to the varying needs of teachers and accessibility for teachers also factored into the decision making process around the articles to select. Three of the articles were located through a search of the Eric database using the search terms professional development, technology integration, teacher education, Canada and mathematics. Dalgarno and Colgan’s article was retrieved through Google Scholar as the full text was not available through Eric. Garet, Desimone, Birman and Yoon’s research paper was chosen from folder 7 in the etec 533 library, located in the CiteULike service. This set of articles provides current research for exploration and analysis.

**Annotated Bibliography**

*Article one*

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes development effective? results from a national sample or teachers. *American Educational Research Journal, 38*(4), 915-915.

Garet et al.’s study used a national probability sample of 1,027 mathematics and science teachers to present a comparison of effects of different characteristics of professional development on teachers' learning. This study was published in the American Educational Research journal and addressed the important issue of effective professional development for math and science teachers. The study identified the core features of professional development as; focus on content knowledge, active learning and coherence to other learning activities that have significant positive effects on teachers' self-reported increases in knowledge and skills and changes in classroom practice. The study also identified structures that affect teacher learning. These structures included duration of the PD activity, collaborative participation of teachers from the same school and the PD format. The fact that these results were based on teacher self reports has implications for schools and district planning of professional development. Results of this study suggest that effective PD should be of a sustained duration, focus on academic subject areas, and give teachers opportunities to participate in active learning activities that are integrated into the daily practice of their classrooms. These findings are important to keep in mind to plan for future professional development sessions for effective technology integration in mathematics and science.

*Article two*

Giordano, V. A. (2007). A professional development model to promote internet integration into p-12 teachers' practice: a mixed methods study. *Computers In The Schools*, *24*(3/4), 111-123.

## This qualitative, quantitative study, investigated the effects of a three year PD model, Project REFLECT (Realizing Education’s Future: Learning through Evolving Cyber Technologies) on the instructional practices, teacher attitudes towards technology and teacher perceptions of the PD model. The study was published in the journal Computers In The Schools, an interdisciplinary journal of practice, theory, and applied research. The focus of this study was on teacher integration of the internet into teaching and learning situations. Participants were selected from 44 p-12 schools. Data was collected through multiple sources both surveys and interviews to ensure reliability of the results. Results of this study suggest professional development that incorporates authentic experiences, promotes teacher collaboration and was applicable to a wide range of educational disciplines leads to changes in teachers’ practices and that some of the changes persist over time. Although these results are supported by the literature included in this research study, administration of the surveys may be questionable as teachers were left to complete surveys unsupervised and may have compared answers.

## In terms of the issue at hand, these results warrant close consideration. Of particular interest in framing the professional development issue were factors identified in the teacher interviews. When trying to affect change in teacher practice, it is important to provide PD that promotes collaboration between teachers in authentic classroom activities and in a variety of curriculum areas. In the planning of teacher professional development, districts and schools need to consider these factors and ensure that professional development sessions incorporate these elements.

*Article three*

Bennison, A., & Goos, M. (2010). Learning to teach mathematics with technology: a survey of professional development needs, experiences and impacts. *Mathematics Education Research Journal*, *22*(1), 31-56.

Anne Bennison and Merrilyn Goos are faculty members at the University of Queensland, Australia. This survey research was published in the Mathematics Education Research Journal and answers questions regarding the implementation of various technologies into the curriculum of secondary mathematics teachers in Queensland. The focus of this study was on technology related professional development experiences and needs, characteristics of teachers who participate and the relationship between participation in the professional development and teachers confidence, and beliefs in technology use. School technology surveys and teacher technology surveys were sent to 456 secondary schools. The return rate of surveys was low, 20% for Schools technology survey and 28% for Teacher technology survey. Results indicate that lack of time and access to computers is a barrier to teacher participation in professional development. Also professional development linked to classroom curriculum and tied to enhancing student learning will bring about changes in teacher classroom practices.

Although return rate of both surveys was very low, the results were similar to those reported in the literature and are relevant to administrators/schools, districts and those who are trying to promote the use of technology in mathematics classroom. The most important message of this study relevant to reframing the professional development issue was that teaching educators how to integrate the technology into classroom practices is vital and should be a focus of any sessions. When designing professional development sessions, it is important to ensure that activities were practiced in classroom settings.

*Article four*

Dalgarno, N., Colgan, L. (2007).Supporting novice elementary mathematics teachers’ induction in professional communities and providing innovative forms of pedagogical content knowledge development through information and communication technology. *Teaching and Teacher Education, 23*, 1051-1065.

Nancy Dalgarno and Lynda Colgan are members of the Faculty of Education at Queen’s University. This article was published in Teacher and Teacher Education, an international journal of research and studies. Dalgarno and Colgan’s qualitative study examines how the needs identified by 27 elementary teachers can be supported through an alternative professional development forum. Connect-Me, an online collaborative mathematics Community of Practice was used for this purpose. Participants in this study were novice (less than 5 years experience) elementary mathematics teachers, with varied backgrounds, ages, teaching experience and geographic locations. Data was collected through two 90 minute focus groups and 16 telephone hour long interviews. A semi structured interview script was developed to be used in both the focus groups and interviews. Inductive data analysis method was used to construct patterns of meaning in the data. Results support the use of alternative forms of professional development, use of technology-enhanced environments to deliver professional development and the formation of professional communities of practice to provide ongoing support to math teachers. The results of this study are based on data collected from Connect- Me, a virtual community of 245 novice teachers. To strengthen the validity of these results further research needs to be conducted using a variety of technology-enhanced environments and a broader sample of teachers with a range of years in teaching mathematics.

Delgarno and Colgan (2007) add a new dimension to the professional development issue. However in framing the issue the use of technology as means to deliver ongoing professional development and support math teachers had not been considered but could be effective in promoting sustainable PD. This research has led to reframing the PD issue to include COP and technology-enhanced environments. The results of this study are important to decision makers in the development of future professional development models to support mathematics teachers. It raises some interesting questions. How can technology enhanced environments be used as an effective component of professional development? How can technology-enhanced environments facilitate the development of Communities of Practice to support mathematics teachers?

**Conclusion**

Technology integration is an active process defined by individual teacher qualities, levels of technology competency, technology professional development and school contexts. The integration of technology into the teaching and learning that occurs in the mathematics classroom is not a simple task. According to Giordano (2007) “The teacher is the gatekeeper of change in the classroom, and professional development designed to change teacher practice must be guided by and integrated with teachers’ existing values, valences, knowledge and behaviours”. (p. 123)

Providing teachers with technology and PD that addresses how to use the technology does not ensure that it will be used to enhance teaching and learning. Whether teachers fully integrate technology in mathematics classrooms is based on a myriad of variables, with professional development being a key factor. However, not all forms of professional development will lead to technology integration and one size fits all professional development will not suit all teachers’ needs. In terms of the original framing of the issue of professional development many assumptions have been supported by the literature. The original premise that professional development that is teacher driven, long term, incorporating support in authentic classroom situations, and clearly linked to curriculum outcomes and gains in student learning appear to be the most effective. Garet et al. (2001), Giordano (2007) and Bennison and Goos’s (2010) results support the importance of linking PD to curriculum areas, and providing sessions which teach how to integrate technology into math curriculum. In the interview, this need was clearly communicated by the teacher and should be considered in any future planning of professional development sessions. Teacher collaboration was recognized in this set of articles as an important factor which is also supported by the interview data collected in my own school context. The original framing of the issue included authentic practice as a factor in effective PD. However this research clearly stresses the need for an even greater emphasis on authentic classroom activities with links to the teaching of mathematics in classrooms in future professional development sessions. Dalgarno and Colgan’s (2007) article has led to a further reframing of the issue of effective professional development to include alternate forms of professional development and the importance of providing an ongoing forum. The use of technology-enhanced environments to facilitate teacher collaboration, support colleagues when needed and provide greater accessibility for teachers is a powerful alternative to the traditional face to face format. The potential of online COP to facilitate ongoing collaboration between mathematics teachers holds great promise in terms of teacher professional development. The merits of providing teachers an online collaborative space in combination with face to face models as a means of forming Communities of Practice for mathematics teachers within the school and district may help meet a wider variety of needs, be cost effective and support more teachers. Further research on professional development that incorporates both face to face models and online communities of practice is necessary to support the use of this model of professional development. A study of the research done by Etienne Wenger into the use of Communities of Practice to improve performance would also be a beneficial starting point.

References:

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