Achievements and Challenges Encountered by Classroom Teachers Involved in a Research Project: A Reflection

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This paper discusses what being involved in a mathematical inquiry project looks like from two classroom teachers' perspectives, gained throughout six years spent in a longitudinal study. Collaboration amongst all stakeholders has resulted in a deeper understanding of the thinking and reasoning required in the inquiry process and has led to benefits to students and significant pedagogical change extending across all curriculum areas.

Being involved in collaborative research projects offers opportunities for teachers to extend themselves beyond their comfort zone and brings the realisation that teachers do not need to be the font of all knowledge. This paper tells the story of two teachers' journeys as they engaged in a longitudinal study. Initially, we were sceptical and tentative as to how this would impact on our ability to deliver curriculum objectives within the needs of the project. Over time, we realised that the thinking and reasoning that students experienced in inquiry resulted in better interactions in the classroom in ways that crossed over into all areas of the curriculum. As our confidence grew and we became part of a learning community, we were better able to broaden our pedagogical practices to adopt inquiry both within and external to mathematics. Positive responses from within the school resulted in sharing of practice beyond our classrooms to cluster and regional schools. Further engagement with the state education body affirmed our beliefs about the benefits of inquiry in the Australian Curriculum.

Being Involved in the Research Project

Volunteering for a research project was an unknown, but suggested a potential way to upgrade our skills in an area in which we were interested in learning more. While we were extremely apprehensive, particularly about having our lessons videotaped, our curiosity was triggered and we experienced some excitement about the upcoming challenge.

For the first time, we questioned familiar pedagogical practices that had worked for many years. Where we had previously expected our students to answer our closed questions, inquiry encouraged our students to take more active roles in their learning, exploring various alternatives to reach solutions. To enable students to do this, we had to consciously change our questioning techniques to a more open format. Listening to our students question ideas provided us with new insights into their thinking and reasoning. Reflection became an integral part of our practice, providing us with alternative ways to move struggling or disengaged students forward, and ways to adapt our teaching sequence to incorporate students' ideas.

It was reassuring in the early stages of the project to discover other project teachers were having similar experiences as they built confidence in using inquiry. The professional discussions and reflection sessions provided positive encouragement and useful ideas that could be adapted for use in our classrooms. Being responsible for writing or finding the units to be covered was at times onerous, but rewarding. Initially, we opted for commercially written units as we grappled with developing a classroom culture conducive to inquiry based learning. As our confidence grew, we elected to write our own inquiry

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units. Writing units allowed us to adhere more closely to mandated curriculum requirements and choose contexts that were more suitable contextually to our students. Developing our own units made us more conscious about foregrounding the mathematical intent and ensuring we provided sufficient opportunities for students to communicate their thinking and reasoning.

Benefits to Students

Seeing students' self-esteem grow was one of the most rewarding aspects of the project. Once students accepted their opinions were valued and it was beneficial to both build on others' ideas and use their background knowledge, their confidence to contribute to the task increased considerably. Students soon began to realise the ability to accurately complete mental and written computations was not the only gauge of a good mathematical thinker. Time and time again we discovered those students less confident in traditional mathematics were often the students who offered insightful comments. These comments revealed not only the depth of their understanding, but their ability to mathematically articulate this understanding and communicate their findings.

Justification is a big component of inquiry. Once students came to understand evidence was required to support any claims made, the need for data collection and representation became second nature. Initially, students needed explicit modelling on how to answer inquiry questions, using justified conclusions linked to the evidence they had collected and represented. As students became more competent using justifications to support solutions, they were more willing to persevere when tasks became challenging and were prepared to attempt different approaches to solve the task.

The real benefit to students was the ability for us to differentiate learning for our students. Working in small collaborative groups, students took ownership of the inquiry task, making decisions about the appropriate mathematical tools, representations and computations required to gather, represent and interpret the evidence necessary to communicate the conclusion to a given audience. Mathematical content needed by groups was revised or taught as mini lessons where necessary, to enable students to progress in a meaningful way. Further opportunities arose for us to conduct explicit mini lessons as mathematical misconceptions or misinterpretations were observed.

Expecting all group members to both contribute to defending the group solution and respond to feedback encouraged engagement, active listening and further justification within the whole presenting group. This also highlighted to the groups the importance of having sufficient quality evidence to enable them to make confident, justified claims. Expecting all audience members to provide constructive feedback or a response for clarification to the presenting group encouraged active listening and substantive conservation driven by the students and not by us. Using scaffolding in the early stages of inquiry, such as question stems and modelling, helped us elicit from students more meaningful requests for clarification, constructive feedback and deeper substantive conversations.

What we Gained

Throughout the project, we have learned a way to foster students' love of mathematics by giving them opportunities to transfer and apply their understanding in different contexts. Our involvement in the project allowed us to experience many of the same benefits as the students. Professionally, we have become more collaborative with our

colleagues, jointly constructing units of work, engaging in discourse and sharing inquiry practice and experiences.

With inquiry now an implicit part of our teaching pedagogy, the transition to the Australian Curriculum in 2012, was less daunting for us than previous curriculum changes. The thinking and doing of mathematics outlined in the Proficiency Strands had already become part of our practice so the implementation focus for us was mainly the difference in the content.

Regular Professional Development Days led by the project researchers maintained our focus on inquiry practice and allowed us to share our inquiry experiences with other project schools. This access to a broader learning community was invaluable. The researchers' different areas of expertise provided opportunities for us to hone our mathematical content in statistics and proportional reasoning. The implementation and effective use of collaborative groups, essential to successful inquiry practice, was another field of expertise in which we were mentored.

Traditionally, assessment of primary mathematics has been testing of content knowledge and application of algorithms, rules and formulas. Inquiry provided us with a repertoire of ways including reflection, peer and self-evaluation and communication of solutions to assess students' thinking and reasoning as well as their mathematical understanding.

Overall, our inquiry experiences have been challenging but have refreshed our professional enthusiasm to continue modifying our teaching pedagogy to cater for the needs of the current generation of students.

Outcomes and Resources: Building Knowledge of Inquiry

The collaboration within our broader learning community has created a number of outcomes and resources, not just for project teachers but for the whole teaching profession. Initially the concept of inquiry was new territory for us, and we looked for existing resources to provide units of work. The disadvantages of these resources were they were not written for the Queensland curriculum and they were unrelated units that were not linked to the current classroom topics. However, they were a useful resource as a point of reference. The need for relevant units of work was tabled as a priority on Professional Development days. This challenge was adopted by one of the researchers and two of the project teachers who produced a published series of books based on units of work actually taught within the classroom (Allmond, Wells, & Makar, 2010). Writing the books highlighted the need to design frameworks to scaffold the inquiry process. The 5D Inquiry Model and the Evidence Model were developed and project teachers were provided with the resources and in-serviced on their use. For us, the most notable student outcome from the project was the students' perceptions towards mathematics. Students were more willing to persevere and take risks when solving challenging problems. They realised that there may be several ways to answer a question and the need to articulate the method they use.

The research project was supported and valued by our school and we were given opportunities to attend conferences and seminars to further develop our understanding of inquiry based learning. Sharing our expertise was encouraged. Over the course of the project we presented at whole staff meetings, year level meetings, cluster meetings, state conferences and mentored other staff as they began their inquiry journey.

Recommendations

Researchers interested in approaching teachers about involvement in a project should clearly indicate the nature and purpose of the research and the commitment required by all stakeholders. Projects should be relevant and engaging for participants and beneficial to all parties concerned. It is important that researchers realise time is precious to teachers, who constantly struggle to complete curriculum requirements; this requires flexibility on the researcher's part to work around suitable time slots. Most classrooms have students with special needs and behavioural issues, which can have significant impact on student performance on any particular day. Support for teachers is crucial. This could take the form of regular professional development, feedback or resources to meet the required outcomes of the project.

Teachers approached to participate in a research project should ensure they have a clear understanding of the commitment required from them and their students, and the purpose and value of the research to all stakeholders. Be aware that any research project will impact on your time and your students' learning time. Projects that are relevant to your context and able to be successfully integrated into your setting are optimal. Approval from school administration is mandatory before accepting. There will be challenges to work through along the way but it is important to persevere where possible, communicating and problem solving your concerns with the researchers. All stakeholders invest time and energy in research projects and for the project to be successful all parties need to be respectful, flexible and work collaboratively. Working on a research project is rewarding, giving you the opportunity to become part of a professional learning community to update your skills and to keep abreast of the current trends in education.

School leaders interested in collaborating in a research project should consider the value and purpose of the research and the impact it will have on the school community. Where possible, commitment should be voluntary and the added teacher workload manageable and supported.

References

Allmond, S., Wells, J., & Makar, K. (2010). *Thinking through mathematics: Engaging students in mathematical inquiry.* Melbourne: Curriculum Press.