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Journal of Teacher Action Research - Volume 6, Issue 2, 2020
practicalteacherresearch.com, ISSN # 2332-2233

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Journal of Teacher Action Research

Volume 6, Issue 2, 2020

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About the Journal

Founded in 2013, the Journal of Teacher Action Research (ISSN: 2332-2233) is a peer-reviewed online journal indexed with EBSCO that seeks practical research that can be implemented in Pre-Kindergarten through Post-Secondary classrooms. The primary function of this journal is to provide classroom teachers and researchers a means for sharing classroom practices.

The journal accepts articles for peer-review that describe classroom practice which positively impacts student learning. We define teacher action research as teachers (at all levels) studying their practice and/or their students' learning in a methodical way in order to inform classroom practice. Articles submitted to the journal should demonstrate an action research focus with intent to improve the author's practice.

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USING ACTION RESEARCH TO DEVELOP DATA LITERACY IN INITIAL TEACHER EDUCATION

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Abstract There is a call for higher education institutions and professional learning providers to support pre-service teachers (PST) in developing competency in data literacy through clinical (classroom) practice. However, PST rarely have the opportunity to collect and analyze data that is relevant to their own classroom practice. In this paper, we put forward the results of a study that centered on PST conducting their own action research project during a ten-week professional experience placement in a high school. The aim of the PST's action research studies was to demonstrate that their data-driven pedagogical decisions had a positive impact upon their students' learning outcomes. It was found that while all of the PST could develop a research question and collect data, they needed more explicit training in action research and data literacy skills to develop a range of competencies that would support them in making nuanced data-driven learning and teaching decisions in the classroom.

Keywords: teacher action research, initial teacher education, data literacy, professional learning, Proof of Ongoing Learning (POOL)

Introduction

There is a call in research for higher education institutions and professional learning providers to encourage competency in data literacy through clinical (classroom) practice

(Bocala & Parker Boudett, 2015). The consensus is that providers should offer courses that combine training in real school settings using authentic examples, such as data from their own school or local area (Mandinach, Friedman, & Gummer, 2015). These studies put forward a similar line of argument, in that in-service teachers need ongoing access to professional learning using authentic data in real world contexts. While there is a growing body of literature on in-service teachers and data training, there is a lack of research on how best to train pre-service teachers (PST) in developing their data literacy (Reeves & Honig, 2015). There is limited research on how to skill PST in using data in terms of what data they will access, how to collect and analyze data, or even how to present the story of the data in a format that is appropriate for stakeholders to understand. These are the skills necessary for being data literate. Gaining these capabilities is confounded by the complexities of providing PST with access to authentic learning contexts during their initial teacher education.

The aims of the study were to show how PST, while on a 10-week professional experience in a high school, demonstrated Proof of Ongoing Learning (POOL) and how their pedagogical decisions had a positive impact on their students' learning. The PST undertook an action research project that centered on their own classroom context. Here, we examine the PST's understandings of how and why they undertook the action research project, and how they collected and represented their data to determine POOL. The notion of POOL is put forward by the authors as a means of understanding how being data literate has a significant impact the role of teachers. Being able to *prove* that a student is learning is at the center of teachers' work where learning occurs over the period of a set timeframe, such as across an academic school year. It is important for PST to have the skills and strategies to be able to collect and measure data to show that their students are learning, where and when they are learning, and how the learning can be further enabled. We argue that action research provides the framework through which PST can make informed learning and teaching decisions. The research questions that framed the study are:

- (1) What is the role of action research in initial teacher education?
- (2) What drives PST in their decisions to collect and use data?
- (3) How can professional learning sessions in data literacy be better designed to facilitate deeper learning for the PST?

Literature Review

Data literacies in initial teacher education. In initial teacher education, data literacy in the classroom is gathering attention as a necessary graduate skill. Data literacy has been put forward as being a panacea for school and system improvement. Data literacy includes data-rich activities ranging from local school-based assessments and examination results to state, national, and international benchmarking (standardized) assessments. It has been argued that educators need to be taught how to use data to identify sub groups, challenge views on students and student progress, understand student thinking, and to confirm what they know about them (Quint, Sepanik, & Smith, 2008). The research clarifies that educators are increasingly responsible for making use of these multiple sources of data about student learning and school-based decisions as ways of seeking improvements in teacher

professional learning and school management (Bocala & Parker Boudett, 2015; Coburn & Turner, 2012; Wayman & Jimerson, 2013).

Vendlinski and Phelan (2011) posit that effective professional learning initiatives should focus on providing three aspects of development: developing the content knowledge of teachers in the domain of use; developing a community of teacher learners, in this sense a Community of Practice as articulated by Lave and Wenger (1998); and allowing teachers to explore students' work including both accurate and inaccurate examples. Studies have demonstrated that in-service teachers favourably viewed classroom-contextualized interventions using authentic data, preferably from their own school or district, and that they value opportunities for collaboration and the social framing of data use (Farley-Ripple & Buttram, 2015; Gerzon, 2015). Mandinach and Gummer (2015) found that while teachers have some understanding of how to use data, they lack the skills to be effective. Mandinach and Gummer (2015) further articulate that teachers working in teams can compensate for the individual lack of competencies thus further advocating the social framing of data literacy put forward by Farley-Ripple and Buttram (2015).

Educators and those training to be educators need mastery in their data skills in order to be able to work as individuals and to be part of collaborative conversations on using evidence to make instructional decisions (Bocala & Parker Boudett, 2015). In their research on PST data literacy, Reeves and Honig (2015) contend that, "data literacy can assist teachers in moving from an intuitive, disorganized, undocumented, "in the head" process of assessing their students to a systematic, consistent way of monitoring student progress" (p.90). Educators need to be able to collect appropriate data to inform learning and teaching decisions and to be able to present these decisions and their effects to their key stakeholders. This need for data creates a push back on higher education providers that offer initial teacher education programs to upskill PST in being data literate as there is an expectation that PST will graduate with the capacity to collect, analyze, and produce data and data driven outputs.

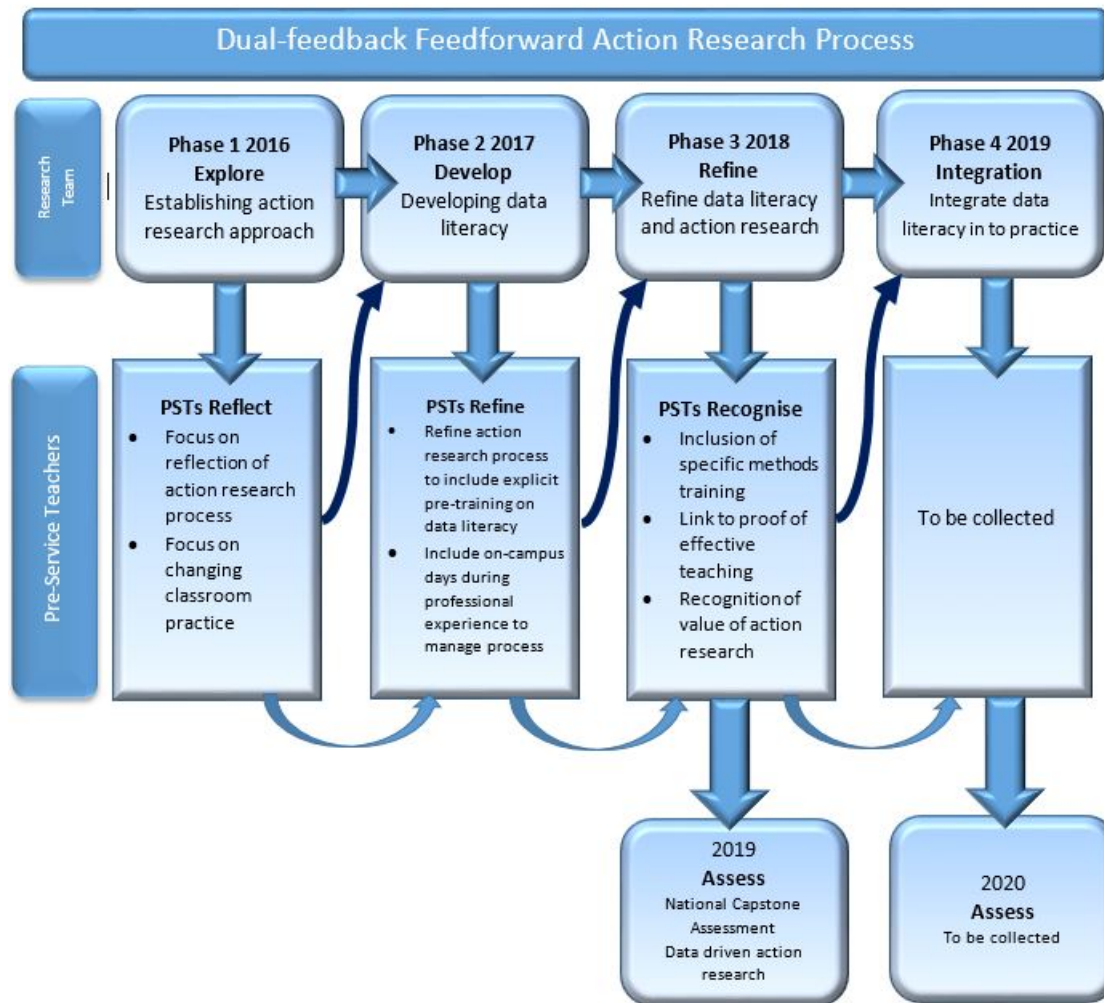


Figure 1: Dual feedback action research model

Action research in initial teacher education. Action research, in general, falls within a qualitative research paradigm and centers on research undertaken on action (Cohen, Manion, & Morrison, 2007). The methodology and methods used to conduct action research are diverse (Cohen et al., 2007; Kemmis & Mc Taggart, 2000). The expansive body of literature on action research, which spans more than seventy years, articulates four key features characteristic of action research study (Lewin, 1946; Mertler & Charles, 2008; Cordeiro, Baldini Soares, & Rittenmeyer, 2016). These four characteristics being: 1) participation and collaboration; 2) a constant and iterative cycle of self-reflection, which includes planning, acting, observing, and reflecting; 3) knowledge generation; and 4) practice transformation. The action research model applied in this study was based on the four phases and relied on dual modes of feedback to refine the overarching research design and the PST's action research model and data literacy training. The study also draws upon the action research model put forward by Kemmis and McTaggart (2000), which is centered on an ongoing cycle of planning, action, and reflection. Traditionally, an action research study may have a clear beginning; however, there is often no clearly defined endpoint. The

current study is in its fourth year, and with each round of data collection we have developed a deepened understanding of how action research can be used to inform course design. The study, which commenced in 2016, was designed to run over several phases. Each phase of the research constitutes one course offering (i.e. the course is offered annually). This paper is centered on Phase 2, and the data was collected from July to November 2017.

A central feature of action research is that revisions and improvements are made within a cycle so that changes are implemented as part of improving the outcomes/design in the following and subsequent cycles. This can be seen in the model (Figure 1) where there is a dual-feedback loop. The cyclical nature of action research provides opportunities for both educators and PST to learn from the previous research phases (Mertler & Charles, 2008). Feedback from students has been shown to be a valuable resource for improving the learning designs (Mandouit, 2018). In this sense, the design of this action research project is a significantly iterative process where the researchers refine the model and the materials; the PST learn from their own experiences and from viewing past assessments, the PST feed their new knowledge and experience into subsequent assessments and teaching, and the research team keep learning after each iteration. The PST used a linear action research process as this worked well with the design of their course and professional experience (Figure 2).

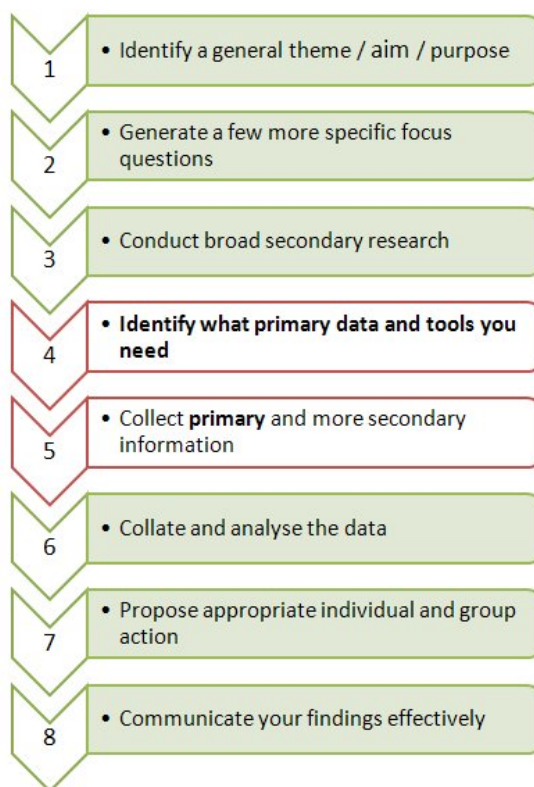


Figure 2: Action Research Model (preservice teachers)

Methodology

Research context. In order to develop their data literacy, PST in Year 3 of their secondary teacher education program were required to undertake an action research project while on

professional experience. PST were required to identify a research area and relevant research questions for the development of a research study that integrated the collection and analysis of data. This provided the PST an authentic learning and teaching experience. The PST participated in a one-week intensive course on high school teaching methods prior to their professional experience. The intensive course comprised 20 hours of face-to-face classes (i.e. five days of four-hour classes). The remainder of the course (i.e. six weeks of four-hour classes) was conducted post professional experience. The methods course is a mandatory course for initial teachers in the State of New South Wales (NSW Education Standards Authority, 2017). As part of the intensive week, PST attended lectures/seminars about action research; the importance of developing a research question; and the basic statistical functions necessary for teachers to use, such as data displays using box and whisker diagrams and scatter charts. Basic statistical metalanguage was explicitly covered in the workshops, and terminology, such as population group, pre-test, mean, median, participants, data, data analysis, and visualizations, was also addressed.

In the first fortnight of their professional experience, PST had to identify a learning and teaching issue and develop a strategy for implementation in one or more of their classes. They were then required to design an action research study. Scaffolding was provided to guide PST through the required cycles of learning so they were better able to implement their interventions. The completed action research projects were submitted at the conclusion of semester as a summative assessment. A scaffold was provided to support PST in writing up the results of the action research project. The scaffold was in the format of a journal article template. This was deemed an appropriate format as the PST were familiar with academic papers, and it provided the PST with an understanding of how research papers are generated.

Data Collection and Analysis

Participants. This study involved a cohort of third year PST at a metropolitan university in Sydney, Australia. The PST must study two Key Learning Areas (KLA); for example, maths and English, as part of a secondary teaching degree. Twenty-five PST submitted their action research projects for analysis. This is a 56.8 percent response rate, which is viewed as acceptable (Nulty, 2015). Thirty PST completed the survey out of an enrolment of 44 PST. This is a 68.2 percent response rate, and is viewed as an acceptable response rate in social sciences research (Nulty, 2015). No persuasive measures or incentives were offered to participants to participate in the study. It should be noted that the researchers are also participants in the study; however, our views are not presented here.

Action Research Projects (summative assessments). The action research projects were submitted as summative assessments. They were not analyzed until after the PST's final grades were confirmed. The data was coded thematically, and the themes were drawn from the action research project template that the PST were provided with to present their findings. This approach to coding is deemed appropriate by Mason (2012). We were aware that when we were coding the projects that the categories may not be consistent and that

there was likely to be some blurring between the codes. In particular, we expected to have some cross over in the categories for the area of research, data sources, and methods of visualization as these were unpacking the PST's own understanding of their research design.

Survey. The survey was administered at the University during an on-campus session one week after PST completed their professional experience. It was an expectation that the PST had already generated a draft of their action research findings so that they would be able to respond to the survey. The survey comprised 15 items. Twelve items were open-ended and three provided listed options. The survey was first administered in 2016 to a cohort of PST completing the same, albeit now revised, project (Kennedy-Clark et al., 2018). Analysis of the surveys involved discovering patterns, themes, and categories in the data. This was essential as these themes and categories could be used in the later phases of the study in subsequent years. Simple frequency analysis was used for analysis and the frequencies are represented as percentages.

Results

Two sources of data are presented in this paper: the action research projects (final PST assessment) and a post-intervention survey. The three main themes to be discussed in relation to the data are 1) action research and the role of action research in initial teacher education; 2) research topics and data collection techniques; and 3) PST's perceptions of action research project.

Action research projects. The action research projects are PST's final summative assessment that reported on the findings of their action research study. The action research projects were analyzed individually using these pre-determined themes: research area, literature sources (secondary evidence), data sources, data visualization, and level of competency. From the 25 action research projects that were analyzed, it was evident that 14 of the PST's projects were deemed to be at a novice level of competency, nine were deemed to be developing, and two were not included as alternative assessments were submitted. The measure of novice, developing or competent was based on the PST's selection of the visualization and its appropriateness for the data source, the level of complexity in describing the data, and the reliability of the outcomes presented. The PST's research projects covered a range of research areas (Figure 3) with the main research area exploring the different teaching methods (60%, $n=15$). The topic of different teaching methods explored different pedagogical strategies, such as problem-based learning, inquiry learning, setting learning goals, strategies for EAL/D students, and scaffolding learning. Three PST (12%) investigated the topic ICT in Education.

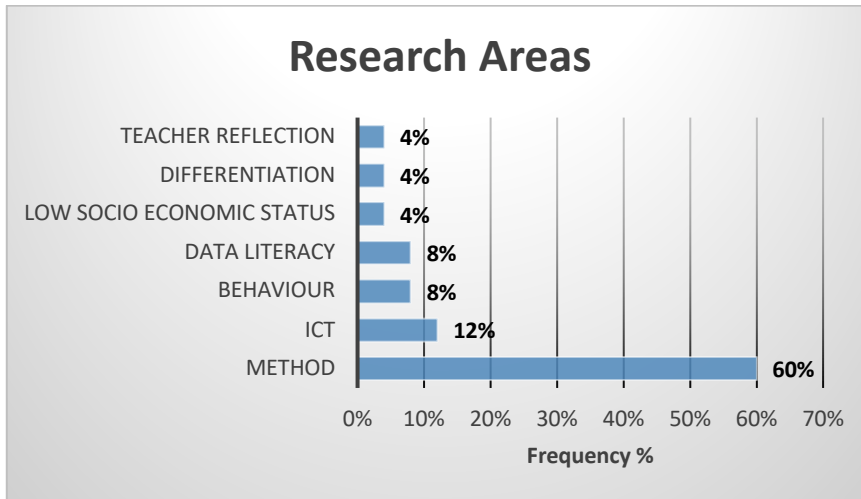


Figure 3: Research areas (topics)

Regarding data collection strategies PST used, twelve PST (48%) had a pre-test, post-test approach with a further ten PST (40%) having a pre-test, mid-test, post-test approach. Two PST (8%) had a combination of observations and documentary analysis. Two PST (8%) did not collect data due to in-school factors, such as changing supervising teachers or class mid-way through their professional experience. A range of data visualization types were used by the PST. Ten PST put forward two visualization types such as bar graphs and pie graphs. These representations are presented in Figure 4, whereby a total of 35 visual representations were analyzed. The most frequently used representations were bar graphs (20%, $n=7$), pie graphs (17.1%, $n=6$), numeric tables and dot plots, both with a frequency of 14.3% ($n=5$). What is evident from the analysis of the action research studies is that the PST were largely able to design an action research project and collect classroom data. However, it was found that the representations used by PST were largely naïve. PST were using pie charts and bar graphs to present test results instead of more appropriate visualizations, such as box and whisker diagrams. We surmise here that the research team needs to provide far more detailed and prolonged support in developing PST's data literacy and data reporting skills.

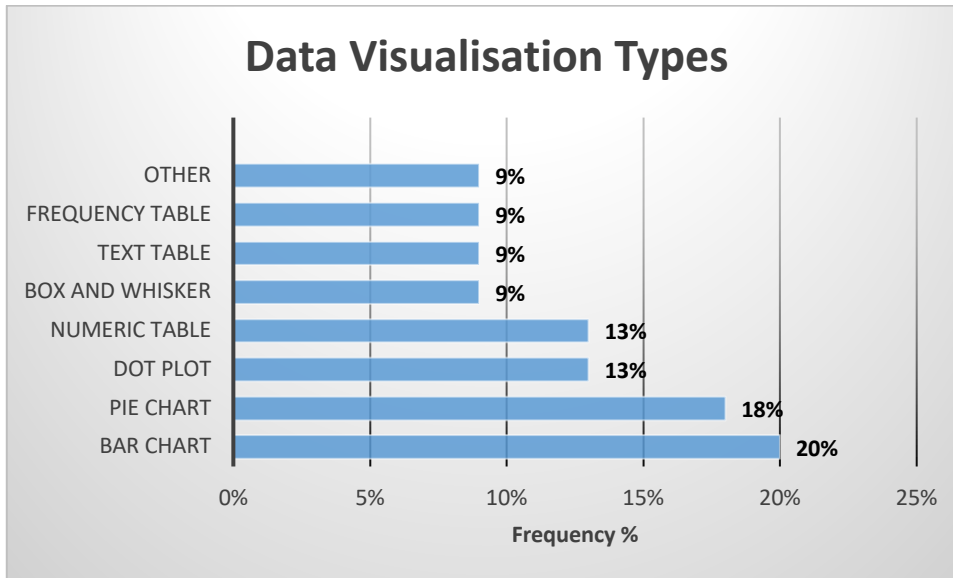


Figure 4: Data visualisation types

Post-intervention survey results. The survey results complement the findings of the action research projects. In some instances, there is an overlapping of the findings.

Action research and the role of action research. In order to provide context on the main research areas, survey item one was aimed to elicit a definition of action research from the perspective of the participants. Less than 30% ($n=9$) were able to accurately define action research in terms of improving or informing teaching practices. One PST specified that action research was:

studies carried out in the course of an activity or occupation typically in the field of education to improve the methods and approach of those involved [female, English teacher].

Thirty three percent of responses ($n=10$) defined action research as collecting data to answer a research question. For example, a PST stated that action research was:

undertaking research aimed at providing data and information showing how different students learn and develop [female, history teacher].

A further five PST (17%) described action research in terms of ongoing practice, undertaken whilst teaching. Three responses (10%) were ambiguous and this impacted upon understanding (e.g. incorrect word choice). For example, “the development of their writing and literacy skills” and “behavior management” were provided as answers. Three PST did not answer. What this suggests is that despite the training sessions on action research and the explicit training in metalanguage, the PST needed more exposure to the concepts underpinning action research. That is, their metalanguage of action research needs a more concentrated effort by the teaching team.

Item two asked respondents to: “Describe your action research project and why you selected this area for investigation. (i.e. what did you do, how did you plan it, and why did you investigate this area)”. Given that this item was asking participants to describe their

own studies, there was, to be expected, a diverse range of answers. Examples of response include:

I researched the effectiveness of positive behavior management on student learning. I compared student centered and teacher centered learning [female, history teacher].

My project assesses the effectiveness of the use of relevant examples in order to enhance learning capacity. This was constantly performed through daily substitution of examples of globalization in order to appeal to a year 8 female class [male, geography teacher].

My action research question is centered around students' interests and how they can have an impact on classroom engagement if incorporated in the content. I planned to collect data by observing my students' behavior and engagement when their interests were incorporated in the lesson [female, history teacher].

What was evident from the analysis of the participant responses it that they were all able to identify a target population and articulate a learning and teaching intervention.

Item three asked the PST to: "Describe your perceptions of the teacher's role as related to action research (i.e. how did you see your role as teacher and researcher)". Fifty-seven percent of respondents ($n=17$) indicated that their perception of the teacher's role was related to improving teaching, student learning, task design, understanding students, teacher as a "guide", assessing learning, and supporting learning. Seventeen percent ($n=5$) were pragmatic about the action research process and described it in terms of actions to be completed without any mention of teaching and learning. In this respect, they made reference to the practice of collecting data rather than the implications of the research on the learning and teaching. Ten percent ($n=3$) saw themselves as a teacher and not a researcher and made no mention of the learner or learning. A further ten percent ($n=3$) provided ambiguous responses in that they were not related to the question (e.g. good and professional). A final seven percent ($n=2$) provided no response. It was positive to see that over half of the respondents linked action research to their learning and teaching

Overall, in relation to the research question: What is action research and the role of action research in education? It is evident that while most PST had a working understanding of action research, they needed more exposure to action research in order to better conceptualise the process. Secondly, the PST needed opportunities to see the connections between collecting data and making classroom decisions.

Research topics and data collection. Several survey items were designed to elicit information pertaining to what the PST thought that their main research topic was, how they collected their data, and why they made those choices. As part of the study, we wanted to understand how the PST knew that their interventions were working. This was to ascertain if the PST could establish POOL. We asked, in item four to: "Describe how you measured if your action research had an impact upon the classroom (learning, behavior etc.) (i.e. how do you know if it worked)". In regards to how PST measured the impact of their interventions, 43 percent ($n=13$) indicated that they used summative measures, such as pre, mid and post-tests. A further 57 percent ($n=17$) indicated that they used a range of formative assessments. These included formal tasks, such as quizzes, work samples, and

experiments, as well as informal measures, such as observations of engagement and participation and feedback.

Item five was a multiple-choice question with a list of research areas, and the PST were able to select more than one option. The research topics covered differentiation, gifted education, assessments, and communication. Given that the action research topics centered on investigating a problem within their classrooms, these topics all fall within the scope of what a teacher would normally encounter in their classrooms, and the findings are consistent with the data gathered from the action research projects.

In item six, the PST were asked to provide their data collection processes. In Figure 5, it is evident that pre-tests and post-tests and student work samples formed the basis of the PST's data (33%, $n=20$). Observation of students in class comprised 26 percent ($n=16$) of the participant responses. What this indicates is that the PST were able to select techniques to measure student learning. What is of note is that item seven asked the respondents why they selected these techniques. It was found that 53 percent ($n=16$) selected data collection techniques that were appropriate, 33 percent ($n=10$) used the easiest measures, and 10 percent ($n=3$) used a range of techniques to get better variety in the data. One PST did not respond.

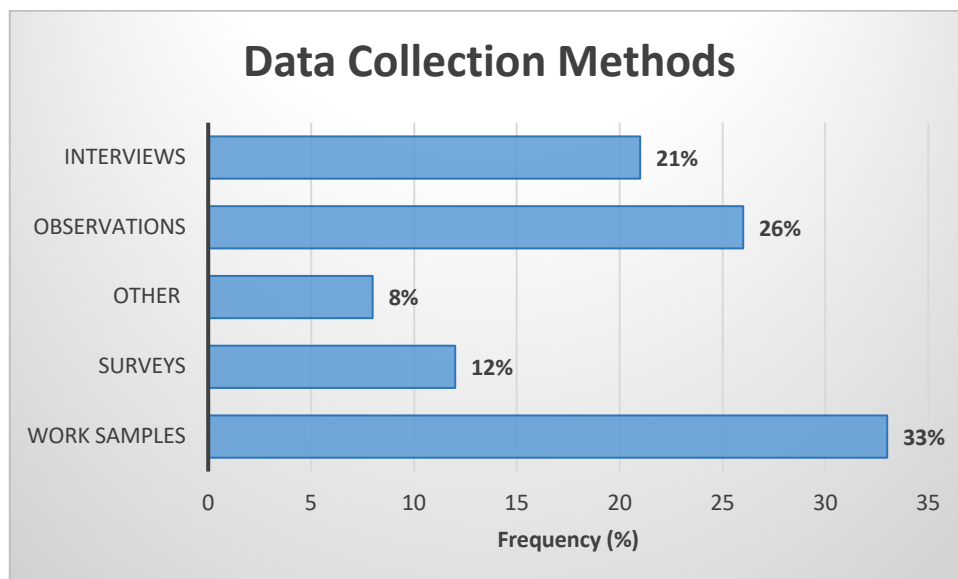


Figure 5: Data collection methods

The aim of items 8 and 9 was to further elicit how PST established POOL using data that they had collected. In item eight, participants were asked: "How did you analyze your data? (i.e. what did you do to make sense of your data?)". The response for this item demonstrate that 47 percent ($n=14$) of the PST used comparative analysis between test results or other student work samples. Twenty percent ($n=6$) of the PST provided descriptive responses about analyzing data into graphs and tables and that is it was related to the visualization of the data. Twenty percent ($n=6$) indicated that they used document analysis of student work.

Thirteen percent ($n=4$) of the PST either provided either no responses or unrelated responses.

The PST were asked in item nine “how they represented their research findings in their action research project (i.e. how did you show what you found)”. This was a multiple choice question. As PST were expected to collect multiple sources of data, we assumed that they would provide multiple responses to this item. In some instances, three to four responses were provided. Results are provided as percentages. Figure 6 expresses that 36 percent of the respondents used some form of text description and 29 percent used a table with numbers. Twenty-one percent of the respondents used a table with text and 11 percent used a graph, such as a box and whisker diagram or a dot plot. Three percent of the PST selected other forms of representation, and these forms included images and verbal analysis.

In item ten, the final question in this section, the PST were asked why they selected these methods of representation. The responses here fell into two broad categories. Sixteen PST (53%) indicated that it was the most appropriate or effective way to show their results. Twelve of the PST (40%) indicated that representing the data as they did was the easiest way to do so. One PST did not respond, and one PST provided an invalid response.

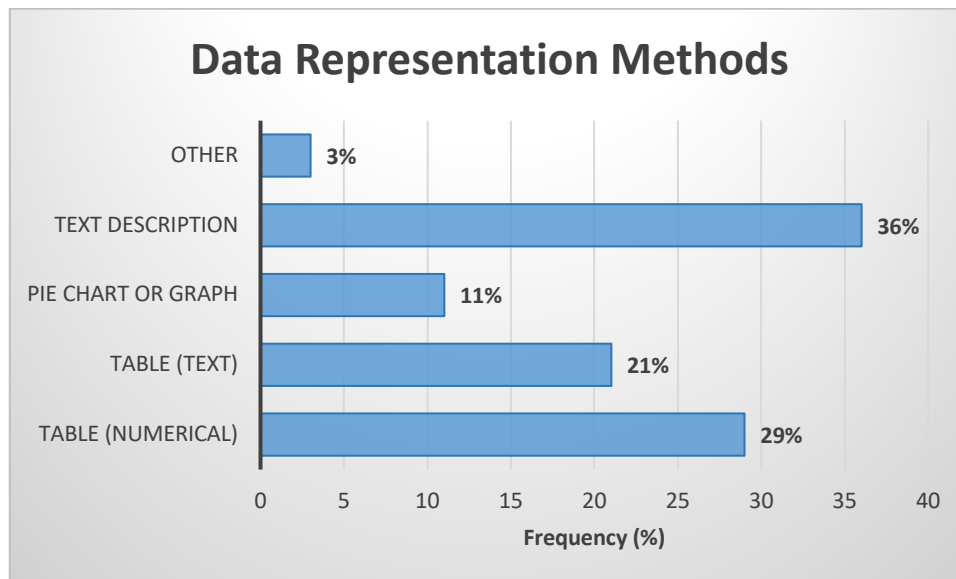


Figure 6: Types of data representation in the action research project

In relation to the research question, “How did students collect and use data (i.e. what drove their decisions)”, it was evident that all of the PST in the study were able to collect a range of data types and to undertake basic analysis. However, it was apparent from the survey results that the choices in some cases were driven by ease rather than effectiveness.

Perceptions of action research. In order to gain an understanding of the PST’s perceptions of action research, they were asked to respond to several items pertaining to the action research process, the challenges of action research, and the potential benefits. When asked about what they needed to know to support their research 47 percent ($n=14$) of the PST

indicated that they needed to know more about how to collect and analyze the data. One PST indicated:

How to improve the results of the next time you test a question [female, drama teacher]

How to gather data better [female, English teacher]

Two PST (7%) indicated that they wanted to know about when to collect the data and how to manage the time requirements. Two PST (7%) indicated that they wanted to know how to measure student ability and not attitudes. Nine PST (30%) provided no answer, a further two stated “nothing” and one PST indicated that it was a waste of time.

Item 12 asked the PST to: “Describe the challenges and benefits of doing action research as a teacher in a classroom”. Multiple responses were provided for this question, where the benefits included getting to know the students and their learning, improved teaching, and knowing if the students are progressing. Examples of responses include:

You see the progression of the students after implementing the action [male, religion teacher]

Helps keep tabs on whether the students are progressing and where they are [male, HSIE teacher]

You can self-evaluate your own teaching practices [male, English teacher]

Some of the challenges raised by PST included that it was time consuming, hard to collect specific data, and there was a split focus between teaching and research. PST responses included:

The challenge is having a concrete aim and distilling the data needed to fulfil the demands of that aim [female, English teacher]

Not everything works. Not everyone will relate [female, maths teacher].

It was evident from this question that PST perceived the benefits in being able to see student learning and the impact of their own teaching. The challenges center on the pragmatics of conducting a research study and the tension between teaching and research. This is linked to Item 13 which asked the PST to: “Describe the impact of the action research on your own teaching practices as related to their participation in the action research. (i.e. how did the action research affect your teaching – if it didn’t and why)”. In response to this question, 53 percent ($n=16$) of the PST indicated that the action research project had an impact upon their learning and teaching strategies and led to a better understanding of lesson planning, lesson content, the use of ICT, and differentiation or different teaching strategies. By way of example, one PST wrote that:

Positively. Helped me to understand my students’ specific learning preferences along with the types of tasks that they liked [female, drama teacher]

A further 17 percent ($n=5$) stated that it helped them to reflect critically on their teaching or to become more observant indicating that it had an impact upon how they viewed themselves in the classroom. For example, one PST claimed that:

I have the opportunity to ask if I've improved and how that came about [female, HSIE teacher]

An additional 17 percent ($n=5$) indicated that they were not sure if the action research had an impact, as one PST stated:

I don't think it did. I'm not sure if I would change my teaching style [female, history teacher]

Two PST stated that it made them focus on the final assessment (7%), three PST (10%) did not respond, and one PST (3%) indicated that they sometimes forgot to do the action research. It is apparent from the responses to these two questions that the action research provided space for the PST to critically reflect upon their own teaching approaches.

The final Items, 14 and 15, gave the PST an opportunity to anecdotally outline their views on action research. Item 14 asked: "As a pre-service teacher, what are your thoughts on action research assessments during practicum? (i.e. good, bad, how they can be improved)", and Item 15 asked "Any final thoughts?" In response to item 14, just under half of the PST (47%, $n=14$) indicated that they found the action research challenging or difficult and this was mainly due to the issue of managing both the time taken to plan and develop lessons and the balancing of this with the action research. As one stated:

Prac is stressful. Maybe when I am an actually teacher it will be better [female, English teacher]

Professional experience is high stakes for the PST, so these comments are understandable. Professional experience is 10 weeks of teaching in a new environment, with new students, and their every action is under scrutiny. There is a need to demonstrate that they have achieved specific teaching standards, so this coupled with an assessable action research project is, understandably, burdensome. Getting support from the supervising teacher also came up as a challenge, as one PST articulated:

Can be quite stressful. My supervising teacher was very resistant to a mid-test. He thought it was useless [male, HSIE teacher]

Thirty-seven percent ($n=11$) of the PST thought that it was beneficial, one supplied:

Good! Helps us focus on our teaching and how we are going. Are we being effective? [female, English teacher]

Four PST (13%) stated that the action research was both good and bad. As one provided:

They are good and bad at the same time as they place more pressure on us but allow us to test our teaching methods [male, religion teacher]

One PST did not provide an answer. In regards to the final item on the survey, only four PST provided responses, one stated "I liked the action research", one wrote "good", one wrote

“very complex” and the final one added “please no more”. What this indicates is that there was a mixed view about the action research. The main barrier lies in the time taken to plan and organize the action research with the PST feeling like it detracted from their actual teaching.

In regards to the third research question: “How can the data literacy sessions be better designed to facilitate deeper learning?” There are a number of recommended improvements including more explicit training in the metalanguage; more exposure to the data collection and analysis techniques; and explicit training in writing up the results. The perceived benefits of the action research are that it improved PST’s teaching and understanding of what works in a classroom. It also provided space for a critical lens from which to view their teaching and to establish POOL. That is, by doing the action research, PST had a structured process through which they could establish student progress. In this respect, the benefits do outweigh the challenges as the challenges seemed to be linked to the administration and organization of the action research rather than the action research itself. It could be argued that asking the PST to keep a learning journal or to read academic papers would also be seen as being burdensome. Thus, the overall approach to embedding action research into professional learning has had a positive impact upon the PST. The action research process may also raise their awareness about how to manage their workloads more efficiently and to better prepare themselves for the rigours of the workplace.

Discussion

The results of this study have further strengthened our belief that considerable attention needs to be paid to developing PST’s understanding of action research and data literacy. The results confirm existing research on data literacy in initial teacher education. For example, it was found that conducting the action research in their own classes meant that the data was contextualized and, therefore, more meaningful (Farley-Ripple & Buttram 2015; Gerzon, 2015). One issue raised by Goodyear, Markauskaite, and Kali (2009) is that it may be “all too rare for university teachers to have timely, valid and reliable data on student achievement. This is a major problem in the assessment process itself, but also handicaps any attempts at evidence-driven iterative design” (p.15). This is in alignment with the New London Group’s (1996) claim that Situated Practice is learning grounded in students' own life experiences and draws drawing upon a constructivist understanding of how people learn. Hence, through designing their own study in the context of their own classroom, the PST are situated in the context of the selection, collection, and analysis of their own learning and teaching data, which may create a more nuanced understanding of how data can be used to inform learning and teaching decisions.

Developing an understanding that data literacy for initial teachers includes the development of three skill sets may help address these issues. These three skill sets being: 1) *problem-focused skills*, such as knowing how to frame questions, identify problems, and to make informed decisions; 2) *data-focused skills*, which include knowing how to access, generate, and interpret data; and 3) *process-focused skills*, which include knowing how to engage in collaborative inquiry and to evaluate cause and effect (Mandinach & Gummer, 2013). Hence, for the PST to be considered to be data literate, they should be able to understand, analyze, and to act upon multiple forms of data about student learning (Coburn & Turner,

2012). It was evident from the results that the PST could make learning and teaching decisions on the basis of the data they collected.

Three findings that are linked to the research design are that: 1) it was evident that the PST needed more explicit training in the metalanguage of action research and data literacy. As such, they needed more exposure to a range of data collection and analysis processes in order to make more nuanced choices regarding their learning and teaching decisions; 2) it was evident that while the PST could identify procedures to collect and analyze data in order to demonstrate POOL, they needed more explicit training in how to write up their research findings; and 3) the survey will need to be re-designed to drill down into the three emerging categories (research questions) to gain a more in-depth understanding of why the PST selected particular data sources and data visualizations. Hence, in future iterations of the one week intensive it should be considered that the PST need more exposure to a range of data collection methods. This is so that they have a deeper understanding of why one data collection method or visualization may afford the audience a better understanding of the data.

Conclusion

There are several limitations to this study. There is only a small body of literature on data literacy in initial teacher education and much of the literature is descriptive. We are developing a theoretical understanding of data literacy, and, in this sense, the research may seem nascent. Given that this was a small-scale study that focused on a descriptive analysis, the authors would be hesitant to put forward generalizations about the findings. Further iterations of the study are planned for the coming years to add substance to our claims. However, when taken in the context of larger bodies of work on action research and in-service teachers' data literacy, the findings support the need to have explicit instruction in initial teacher education programs in order to develop much needed classroom data literacy skills.

Acknowledgements

The authors would like to acknowledge the support of Dr. Katrina Eddles-Hirsch for her feedback on action research and differentiated models of instruction. This study has University HREC ethics approval (approval number 017101S).

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References

- Bocala, C., & Parker Boudett, K. (2015). Teaching educators habits of mind for using data wisely. *Teachers College Record*, 117(4), 1 – 20.
- Bryman, A. (2004). *Quantity and Quality in Social Research*. London: Routledge, 2nd ed.
- Cordeiro, L., Baldini Soares, C., & Rittenmeyer, L. (2016). Unscrambling method and methodology in action research traditions: theoretical conceptualization of praxis and emancipation. *Qualitative Research*. 17(4), 395-407. <https://doi-org.ipacez.nd.edu.au/10.1177/1468794116674771>
- Coburn, C.E., & Turner, E.O. (2012). The practice of data use: An introduction. *American Journal of Education*, 118 (2), 99-111.
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education (6th ed.)*. London and New York, NY: Routledge Falmer.
- Confrey, J. (2006). The evolution of design studies as methodology. In R.K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (pp. 135-152). New York: Cambridge University Press.
- Datnow, A., & Hubbard, L. (2015). Teachers' use of assessment data to inform instruction: From the past and prospects for the future. *Teachers College Record*, 117(4), 1 – 26.
- Farley-Ripple, E., & Buttram, J. (2015). The Development of Capacity for Data Use: The role of teacher networks in an elementary school. *Teachers College Record*, 117(4), 1 – 34.
- Gerzon, N. (2015). Structuring Professional Learning to Develop a Culture of Data Use: Aligning knowledge from the field and research findings. *Teachers College Record*. 117(4), 1 – 28.
- Goodyear, P., Markauskaite, L., & Kali, Y. (2009). Learning design, design contexts and pedagogical knowledge-in-pieces. *The Future of Learning Design Conference*. Retrieved from <http://ro.uow.edu.au/fld/09/Program/2>.
- Kemmis, S., & McTaggart, R. (2000). Participatory action research. In N.K. Denzin, & Y.S. Lincoln (Eds), *The SAGE Handbook of Qualitative Research (2nd edition)* (pp. 567–606). Thousand Oaks, CA: Sage.
- Kennedy-Clark, S., Eddles-Hirsch, K., Francis, T., Cummins, G., Ferantino, L., Tichelaar, M., & Ruz, L. (2018). Developing Pre-Service Teacher Professional Capabilities through Action Research. *Australian Journal of Teacher Education*. 43(9). <http://dx.doi.org/10.14221/ajte.2018v43n9.3>
- Quint, J. C., Sepanik, S., & Smith, J.K. (2008). Using Student Data to Improve Teaching and Learning. *Findings from an Evaluation of the Formative Assessments of Student Thinking in Reading (FAST-R) Program in Boston Elementary Schools*. New York: MDRC.
- Lave, J., & Wenger, E. (1998). *Communities of Practice: Learning, meaning and identity*. Cambridge: Cambridge University Press.
- Lewin, K. (1946). Action research and minority problems. *Journal of Social Issues*, 2(4) 34–46. doi: 10.1111/j.1540-4560.1946.tb02295.x.
- Mandinach, E.B., Friedman, J.M, & Gummer, E.S. (2015). How can schools of education help to build educators' capacity to use data? A systemic view of the issue. *Teachers College Record*, 117(4), 1 – 50.

- Mandinach, E.B., & Gummer, E.S. (2015). Data-Driven Decision Making: Components of the enculturation of data use in education. *Teachers College Record*, 117(4), 1 – 8.
- Mandouit, L. (2018). Using student feedback to improve teaching. *Educational Action Research*, 26(5), 755-769, doi: 10.1080/09650792.2018.1426470
- Mason, J. (2002). *Qualitative Researching 2nd Ed.* Thousand Oaks, CA: Sage.
- Mertler, C.C., & Charles, C.M. (2008). *Introduction to Educational Research* (7th ed.). Boston, MA: Pearson.
- New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review*, 66(1), 60–93.
- NSW Education Standards Authority (NESA) (2017). *Program Accreditation Requirements*. NSW Government. Retrieved from <http://educationstandards.nsw.edu.au/wps/portal/nesa/home>
- Nulty, D.D. (2015). The adequacy of response rates to online and paper surveys: what can be done? *Assessment & Evaluation in Higher Education*, 33(3), 301–314. doi:10.1080/02602930701293231
- Reason, P. & Bradbury, H. (2008). Introduction. In P. Reason & H. Bradbury (Eds), *The SAGE Handbook of Action Research: Participative Inquiry and Practice (third edition)*. Thousand Oaks, CA: Sage.
- Reeves, T.C., Herrington, J., & Oliver, R. (2005). Design Research: A socially responsible approach to instructional technology research in higher education. *Journal of Computing in Higher Education*, 16(2), 97-116.
- Reeves, T.C. & Honig, S. (2015). A classroom data literacy intervention for pre-service teachers. *Teaching and Teacher Education*. 50, 90-101.
- Smith, A.R. (2017). Bare Writing: Comparing multiliteracies theory and nonrepresentational theory approaches to a young writer writing. *Reading Research Quarterly*, 52(1), 125–140. doi:10.1002/rrq.153
- Vendlinski, T.P., & Phelan, J. (2011). *Using key conceptual ideas to improve teacher use of formative assessment data. (CRESST Report 794)*. Los Angeles, CA: University of California, National Center for Research on Evaluation, Standards, and Student Testing (CRESST).
- Wayman, J. C., & Jimerson, J. B. (2013). Teacher needs for data-related professional learning. *Studies in Educational Evaluation*, 42, 25-34.

Appendix A: Action Research Survey

First name:	
Course:	
Research Question/s:	
Year group/Stage:	
Subject/KLA:	

Please answer the following questions about your data collection and analysis. Note that there is no “correct” answer. We would like to know about how you did your research

1. What is action research?	
2. Describe your action research project and why you selected this area for investigation. (i.e. what did you do, how did you plan it, and why did you investigate this area)	
3. Describe your perceptions of the teacher role as related to action research. (i.e. how did you see your role as teacher and researcher)	
4. Describe how you measured if your action research had an impact upon the classroom (learning, behavior etc.). (i.e. how do you know if it worked)	
5. What was the main topic of your research?	a. Gifted education b. Learning difficulties

	<ul style="list-style-type: none"> c. Communication d. Differentiation e. Assessment f. Behavior management g. Other (please specify)
6. What data collection techniques did you use to collect your data? (You may circle more than one answer)	<ul style="list-style-type: none"> a. Survey b. Observations c. Interview d. Work samples (tests, student work) e. Other (please specify)
7. Why did you select that/those data collection technique/s?	
8. How did you analyze your data? (i.e. what did you do to make sense of your data?)	
9. How did you represent your data in your findings? (i.e. how did you show what you found?)	<ul style="list-style-type: none"> a. Table (numerical e.g. percentages or numbers)) b. Table (text) c. Pie chart or graph d. Text description e. Other (please specify)
10. Why did you represent your data in this form?	

11. What do need to know more about in relation to data collection and analysis to support your research?	
12. Describe the challenges and benefits of doing action research as a teacher in a classroom.	
13. Describe the impact of the action research on your own teaching practices as related to their participation in the action research. (i.e. how did the action research affect your teaching – if it didn't and why)	
14. As a pre-service teacher, what are your thoughts on action research assessments during practicum? (i.e. good, bad, how they can be improved)	
15. Any closing thoughts?	

